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SOME RECENT ARABIAN EXPLORATIONS

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Up to the outbreak of the war the Arabian Peninsula contained the largest unexplored and unmapped area in the world, outside Polar regions; today, seeing that its southern desert, the "Abode of Emptiness," has not yet been entered, it still retains its bad eminence; but by a smaller margin. For the war opened ways into it which had been closed since the institution of Islam and not only promoted such abatement of its jealous exclusiveness, that its natives were willing, indeed anxious, to furnish reliable information about its internal geography and ethnology, but also brought about European penetration of great districts of which not more than the bare existence had been known to us before. These districts lie chiefly in two provinces, Hejaz and southern Nejd. The last had been visited previously by no representative of western civilization; the first, except for a few points on the coast, only by disguised pilgrims. It remained virtually as dark and hidden a land as the other, since the few furtive western men who penetrated its forbidden interior could not diverge from the beaten pilgrim tracks or show a curiosity inconsistent with their assumed character.

Both these provinces have now yielded their secrets to British officers: the Hejaz to a comparatively numerous group, of which T. E. Lawrence was the pioneer and throughout the boldest spirit; southern Nejd to a single officer, H. St. J. B. Philby, who was the first European for a century to cross the peninsula from sea to sea. It must be explained how these officers came to go where they did, and to reap a scientific harvest in such fields.

The Hejaz

To take Hejaz first. All the world knows that Husein, Emir of Mecca, suddenly threw off his Ottoman allegiance in June, 1916, and hoisted his flag for independence and alliance with Great Britain. All the world does not know that he took this action not only on his own initiative, but upon

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a distinct understanding that he should play his hand alone, Great Britain to help only with such sinews of war as could be got to him in time and as he was capable of using; but not with officers or men. There had been negotiations with him nearly two years earlier with a view to his giving moral support to a rising of the northern Arab-speaking peoples against the Ottoman caliph; but the military operation—a British landing in northernmost Syria—which alone could make that rising feasible was emphatically disapproved by France. The plan was abandoned; Syria was left to be dealt with so drastically by the Turks that all hope of her revolt disappeared; and nothing further was asked or expected of the Emir of Mecca. So matters were to remain for nearly a year. Then to the surprise, and not a little to the embarrassment of Great Britain, the Emir reappeared with a proposition of his own, inspired largely by pity for the Syrian Arabs and by nationalist patriotism, but a little, too, by personal ambition and by fear lest he might soon feel the Turk's hand as heavily as Syria had been feeling it during the previous six months.

British authorities were very slow about accepting an offer which would involve sending arms and supplies, then very difficult to furnish, into a new, remote and unknown theater of war. In view also of engagements to France and her known sensitiveness about Syria Britain could not guarantee more than a small part of what the Emir asked for the Arab people. But after several months of negotiations, carried on under great difficulties between Cairo and Mecca, she did agree to help Husein to revolt on the understanding that all wider questions than those which concerned Hejaz should be left open for future consideration. She knew the Emir to be so ignorant of the exigencies of modern warfare and so little able to put any force into the field capable of meeting Turkish regulars on equal terms, that the most to be hoped was that he might sustain a guerilla in his own rough hills and deserts, which would embarrass the Turks, produce a moral effect on the Moslem world, and keep the Germans from penetrating to the Red Sea coast on the flank of British communications with Mesopotamia and India. As the early months of 1916 went on even these hopes faded. The Emir proved to be even less prepared than had been feared; and he showed himself most unwilling to fix any date for action and reluctant to be guided. From his sons, whom he had sent up to Constantinople, he was receiving unfavorable forecasts of British prospects on the western front; and it is doubtful if he ever would have taken decisive action had the Turks wisely left well enough alone. But they did not. Having scored a success against British forces near Aden, the Turks conceived, in the spring of 1916, the idea of so extending it that they might be able to conduct a campaign of guerilla and propaganda in India and East Africa from a strong base in South Arabia. To that end they sent a picked force to Medina with orders to march down through Hejaz to Yemen; and at the same time they allowed a German party of experts in wireless telegraphy to try to make its way by the coast road and join that force south of the Holy Land. Emirs of Mecca

have so often suffered deposition or death at the hands of such passing Turkish columns that two of Husein's sons, who were at Medina and saw these troops assembling, became uneasy in their minds and warned their father. He saw his danger, sent word to Yambo to have the Germans held up, and despatched an S. O. S. message to a British patrol ship to the effect that he must rise then or never. I was sent down the Red Sea to learn what this message meant and to meet his youngest son, Zeid, on a desolate coral

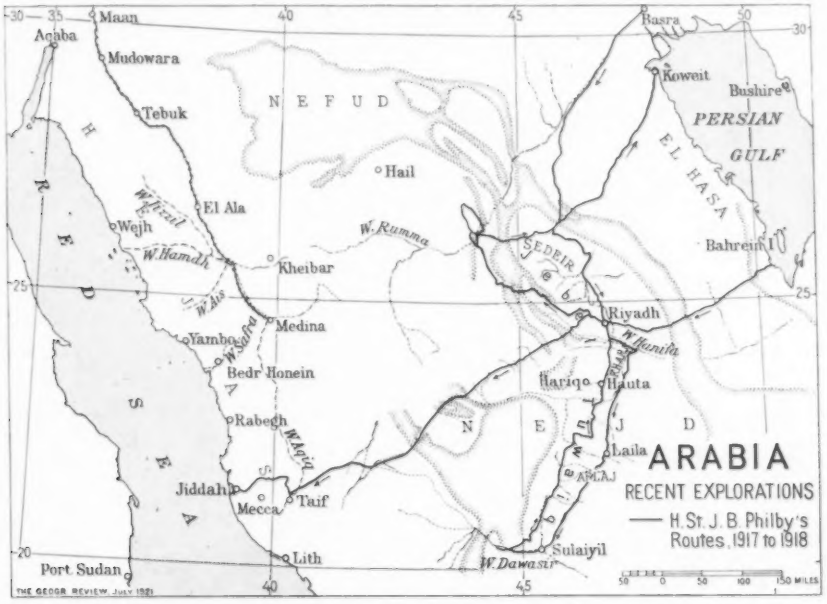


FIG. 1—Sketch map to illustrate recent explorations in Arabia after maps published by the Royal Geographical Society (see footnote 2). Arabic names on the map and in the text of this paper are as spelled by the author. On the vexed question of the transliteration of Arabic names see the note on the Permanent Committee on Geographical Names in the record section of this number of the *Review*.

beach south of Jiddah; but it was too late to interfere. The elder brothers had already invested Medina, and the rising was to begin at Mecca, Jiddah, and Taif on the fourth evening. It duly began—on June 9. British ships and seaplanes helped at Jiddah, and two batteries of Moslem Sudanese were rushed across and sent up to Mecca. That was all that could be done, beyond pushing in money, stores, and old Japanese rifles—the last more dangerous to friends than foes! Neither a British officer nor a British soldier went a mile inland. The Emir played his hand alone.

He found it easier to play after his own desultory fashion than we had feared he might. The Turkish garrisons in southern Hejaz were cut off from help by 300 miles of hostile country; they were ill-found and of very poor spirit. In three months they had all collapsed, except at Medina. In that town the Turks, with the support of the Hejaz railway, had so much

the best of it that the Emir's sons and forces were driven right away and fell back on the coast, Feisal on Yambo, and Ali on Rabegh. The Turks followed up, threatening to move on Mecca. We still believed ourselves

FIG. 2—Jiddah on the arid Red Sea coast owes its prosperity to its function as the port of Mecca.

debarred from participation in operations in this holy land and had no one ashore except a few men to supervise the landing and distribution of supplies at Rabegh; and even these mostly slept on shipboard. As autumn began, it became evident that the Emir had shot his bolt, so far as his own resources went, and was come to a full stop. His revolt had not done our cause much positive good so far, and if it led to ultimate disaster grave injury would be

wrought to British prestige in the world of Islam; for it had begun under British auspices. But what could we do in a forbidden land? We had strength to contribute; but how bring it into play?

FIG. 3—The fort of Aqaba (Akaba). Aqaba at the head of the gulf of that name was a flourishing port from the days of Solomon to those of Saladin, whence dates its decline. Aqaba figured as an important station during the War.

LAWRENCE AND FEISAL IN NORTHERN HEJAZ

At this juncture, in early October, 1916, a lieutenant on the staff, Thomas Edward Lawrence, was sitting in the Military Intelligence Office in Paris. He had had intimate acquaintance with Arabs before the War and had been pulling the strings of the Hejaz affair since its start. Endowed with a

compelling personality, as persuasive as forceful, a very clear head, and extraordinary initiative and promptitude, he thought more rapidly and saw farther ahead than most men. He had always believed that the Arab revolt could be led on to affect greater issues than those of Hejaz, and he felt keenly the danger of its actual crisis. Some single leader must be found for its forces and some liaison with British strength established. He asked leave to take a short holiday trip down the Red Sea on a patrol ship and turned up at Jiddah. There he met Abdullah, the second son of the Emir, and the best known to us of the family. In five minutes he knew this man was not the leader required: but he had heard better things of Feisal who was far away inland from Yambo. Abdullah was asked to call up his father on the telephone (Husein's number is Mecca 1) and get leave for Lawrence to ride inland from Rabegh. The old man demurred to this request but finally gave way and wrote a letter to his eldest son, Ali, who was in command at Rabegh. When this letter came to hand Lawrence went aboard his ship again and dropped down the coast. Ali demurred even more than his father; but Lawrence insisted on his letter and offered to don Arab clothes the better to avoid notice on the way, and to travel by night. Ali agreed at last and Lawrence slipped out of camp one evening with half a dozen Bedouins.

Three days later Lawrence walked into Feisal's tent in Wadi Safra and sat himself down. Feisal was surprised, displeased, and doubtful what his wild Bedouins might think and do; but he put the best face on the accomplished fact and asked Lawrence politely what he thought of Wadi Safra. "Very pleasant and pretty," said his guest, "but a long way from Damascus." There was a moment of acute tension; for Feisal understood perfectly that his failure before Medina and his present inaction were in his visitor's mind. But the tension passed, and he did the right thing. He set forth frankly his situation—his lack of guns and food, the impossibility of his getting up supplies from distant Rabegh, and the incapacity of his troops to prosecute siege operations and railway demolition. Lawrence saw before him the desired leader, and Feisal, as he talked for hours that day and the next, realized that he had found a man who could and would help him. He showed his visitor everything, initiated him into guerilla fighting on the flank of the advancing Turks, and sent him away in peace to sail for Cairo and persuade the British military authorities to organize a new base at Yambo for the supply of a big Arab force, which Feisal undertook to call out at once. The plan was to go north and there cut the railway communications of Medina. All this was done. Lawrence went and came again; and the result was Feisal's march with Lawrence and some 20,000 riders up the coast to Wejh in January, 1917.

From this new base among weak and, on the whole, friendly tribesmen—a base so far north, too, that it fell outside the holiest and most jealously guarded region—we were able to push inland cars, airplanes, and selected officer-instructors. Abdullah had come round Medina with another force

FIG. 4

FIG. 5

FIG. 4—The oasis of Nakhl Mubarak in the Wadi Yambo looking southwest. Emir Feisal's tents in the foreground.

FIG. 5—Abdullah's tents in Abu Markha, Wadi Ais, 1917.

and formed a camp in Wadi Ais, within a day's march of the railway. Not only Lawrence but many other British officers now donned Arab dress, as Feisal's men, and passed up and down, the Bedouins growing accustomed to the sight of them and frankly accepting their instruction and leading. The railway was attacked at many points, and the whole block of northern Hejaz from the coast line between Rabegh and Wejh up to a section of the railway nearly 200 miles long, between Abu Naim and El Ala, became familiar to Christian officers, both British and French. Lawrence was always their inspirer and moving spirit, and his way with the Arabs became our recognized canon of conduct among them.

The Geography of Northern Hejaz

What was learned about the geography of Hejaz by these officers, by the flight of our planes, by the passage of our cars, and by conversations with Feisal, with his officers, and with all sorts and conditions of his rank and file—amounts in sum to this.[1]

Hejaz is one facet of the irregular pyramidal mass of peninsular Arabia, whose apex lies some distance south of Taif. From this culminating point four gable ridges run, one south of west through Asir to the Red Sea about Hali Point, one southwards towards Aden, one northeastwards through Nejd by Sedeir towards Koweit, and one northwards by Kheibar towards Moab. Hejaz is the northwestern facet of this pyramid, enclosed between the first-named and the last of the gable ridges. A short slope falls to the west and a long one to the northwest. The short slope is marked off from the other, which declines towards Medina and Midian, by a great triangular mass of lava-covered highland (*harra*), broadening inland from a point near the sea at Rabegh to a long base between Taif and Medina. This divides Hejaz into two main districts, southern and northern, whose only ways of intercommunication lie either round the point of the *harra* near Rabegh or right round the back of it. The central *harra* itself seems to be virtually uninhabited and almost inaccessible, being not only of most forbidding surface but also without water. Lawrence has told me that he never met a Hejazi, from Feisal downwards, who could tell him anything about it. No one goes there. Our airplanes flew a little way over its mass from Rabegh, but not far. The two great pilgrim roads turn its flanks, the Darb es-Sultani skirting its northwestern face from Medina to Rabegh and then striking inland to Mecca under its southwestern face; the Darb es-Sharqi bending eastwards towards the central steppe, behind the base of the triangle and following up a long watercourse, the Wadi Aqiq, which flows from an elevation of some 6,500 feet at the apex of the peninsular pyramid south of Taif and descends the long northwestward slope to Medina where it joins a main channel called Hamdh. This rises at Kheibar and flows out to the Red Sea near Wejh. We learned for the first time about this great drainage

[1] See also the author's article "War and Discovery in Arabia," *Geogr. Journ.*, Vol. 55, 1920, pp. 422–436.

FIG. 6

FIG. 7

FIG. 6—Typical *harra* in northern Hejaz. This forbidding lava surface presents a serious obstacle to travel.
FIG. 7—Patchy *harra* in northern Hejaz with accumulated detritus which permits the growth of vegetation.

FIG. 8—Bab-el-Omrah, the western gate of Mecca. The pillars mark the limits of the sacred territory.

system from Feisal himself. The total length of its main channel, from beyond Taif to near Wejh, is not much short of a thousand miles; and it has many large feeders in its lower course, e. g. Wadi Ais from the left, which drains the southern part of northern Hejaz, and Wadi Jizzil on the right, which drains the northern part and most of Midian.

Southern Hejaz

Southern Hejaz is a comparatively low-lying tract shut in south and east by the converging gable ridges of the pyramid, and north by the southward face of the central *harra*. It is traversed by short wadis of which the chief is Fatima. This, combining drainage from the pyramidal apex northwest of Taif and from the southwestward face of the central *harra*, makes a strip of fertility a few miles distant to the north and northwest from Mecca before its ground waters sink into the dusty limestones of the low ground behind Jiddah. Shut in and low-lying as it is, southern Hejaz is a torrid, dusty tract with little grazing and therefore is not a Bedouin country. It is inhabited by many small, weak, and very old-established tribes who live on lean cultivation and on what they can make out of pilgrims. It has an economic asset in the city of Mecca, which lies at the back of it just at the foot of the abrupt eastern ascent; and another in the port of Jiddah, which is the main gate of pilgrim access. Easily dominated from Mecca, southern Hejaz is the compact home kingdom of the lord of that city and constitutes a natural holding of the Grand Shereef, extending triangle-wise from Rabegh towards Qunfudah and Hali Point.

The Oasis of Taif

Right above it, towards the peninsular apex, lies Taif, fertilized by the early waters of Wadi Aqiq before, on their way to Medina, they sink too deeply into the porous limestones. Cool and green, its valley commands the pass over the apex towards the southwestern facet of the pyramid, Yemen. Taif has therefore always exercized an important influence on the life of the Hejaz in general and of Mecca in particular; for Mecca, unless it hold this place, has at once no near refuge from the summer heats, no source of green supplies, and no passage towards the food area of Happy Arabia in the south. The Prophet treated it with particular consideration, and the Emirs of Mecca and the Turks have always been studious to keep a tight hold upon it.

Physiography of Northern Hejaz

Northern Hejaz, lying beyond the central *harra*, is reached either by way of Wadi Aqiq and Medina, or by the pass of Rabegh on the sea front. In the south it is a region of high granitic masses, divided by short, steep valleys such as Wadis Safra and Yambo, which make a little fertility in their middle courses. The chief road from Medina comes down the first of these wadis, and the point at which it debouches from the granitic hills has ever been a

scene of Hejaz warfare. There or thereabouts the Prophet, fighting from his refuge at Medina for possession of Mecca and southern Hejaz, won his two greatest victories, near Bedr-Honein.

North of this region the granitic chain runs up the coast in a series of sharp peaks to join the fantastic mountains of the Midian seaboard; and behind it the general denuded slope ascends in long limestone downs towards the main gable ridge, which runs due northward. Before this is reached, how-

FIG. 9—Mecca. Mahmal (holy camel) circumambulating the Great Mosque. Shereef Ali (eldest son of the Emir) in front with white turban and brown robe.

ever, great masses of sandstone emerge, often covered with lava caps, and form a false ridge, which is not the water parting. In the long trough east of these *harras*, but west of the real gable ridge, runs the Hejaz railway. The long continuous upland slope is true Bedouin country, though its grazing is not rich, since it is too far north to get monsoon rains, and too far south to profit much by Mediterranean precipitation. It lies, in fact, in the same rainless belt as upper Egypt. It is seamed with countless deep wadis, almost all converging into that great drainage system which, beginning away beyond Taif, is continued from Kheibar and Medina by the Wadi Hamdh, the most important channel of western Arabia. Its ground waters make the fertile oasis and the prosperity of Medina. Then, after flowing still farther to northward and receiving the confluence of several drains from south (Wadi Ais) and north (Wadi Jizzil), the main channel turns west towards the Red Sea and burrows deep into the slope, becoming

salt and unfertilizing. At one point or another this capital member of the hydrographic system of western Arabia has now all been seen and described, from its estuary just south of Wejh to within about thirty miles of Medina; and its wide ramifications can no longer hide any important secret. We now know northern Hejaz up to the central Hisma plateau of Midian and have learned much about that plateau also by subsequent penetration from Aqaba to the railway between Maan and Tebuk. The railway itself,

FIG. 10—The Great Mosque of Medina: The main dome and the subsidiary domes over the colonnades.

too, has been described to within a few miles of Medina, and its longitudinal position has been determined, in the northern part, from Maan to Mudowara. An eastward error of some miles, as shown on all published maps, was here corrected. Steps are being taken to get more of the railway line determined south of Mudowara. It appears likely that we shall find an eastward error throughout, and that Medina itself is placed too far inland by some miles. There is reason also to suspect that the eastern pilgrim road (Darb es-Sharqi), which runs thence southward towards Mecca and Taif, is charted too far to the east.

Such is Hejaz—a broken, divided, lean land, isolated from the center of the peninsula by a ring of deserts, steppes, and lavas; from the sea by a triple barrier of coral reefs. It is difficult to enter, difficult to hold, and unable to support itself by resources of its own, much less to supply the crowd of pilgrims who annually resort to it; and therefore it is fated to depend on some external society, whether Egyptian, Syrian, or Mesopotamian.

Nejd

Our Knowledge of the Region

Nejd, the inner region of the peninsula south of Wadi Rumma, had come to be well known to us in certain northern parts by the successive journeys of Palgrave, Raunkiaer, Leachman, and Shakespear, the last named having gone across it just before the War. He went up again to Riadh when war broke out, but only to meet death by rashly exposing himself in a fresh phase of that time-honored struggle between rival Emirs which has distracted central Arabia ever since the first half of the last century. The southern part, however, below and to the west of the capital, Riadh, remained wholly unvisited till Mr. Philby made his two remarkable journeys in 1917 and 1918, the one due westward right across the peninsula to Taif and Jiddah, the other southward to Wadi Dawasir and the limits of the Great South Desert.[2]

Philby's Mission in Southern Nejd

The lord of all this vast region, Abdul Aziz, the reigning member of the House of Saud, which grew great in the latter part of the eighteenth century through support of the Wahabite faith, had long feared and resisted the efforts of the Turks to extend their dominion into the center of Arabia. He broke with them in 1913 and turned their garrisons out of the Gulf province of El Hasa, thus obtaining an outlet to that sea and coming into direct touch with British naval power and the Government of India. In the Great War, therefore, his interest lay in espousing the British cause; and at the end of 1915 he concluded a definite treaty with Great Britain. What was asked of him in the War was that he should prevent his rival, Ibn Rashid, the Emir of northern Nejd, from endangering British communications on the Euphrates and supporting the Turks in Hejaz; and to this end Britain supplied him with money and arms. But he made a very poor show with them and proved so unwilling to sink an old feud with Husein of Hejaz that, in 1917, it was determined to send a mission from Mesopotamia to keep an eye on his actions and to persuade him to a more profitable and vigorous line of policy. To head this mission Mr. H. St. J. B. Philby, a civilian officer of the Political Department of India, then attached to the Mesopotamian Service, was chosen. He is an adept in vernacular Arabic, and a man of exceptional courage and endurance.

Philby was well received in Riadh but found little to do there; nor could he arrange matters between Ibn Saud and Husein of Mecca without the presence of some representative of the latter. Certain difficulties prevented the despatch of such a representative, and at last Philby determined to go himself to Hejaz and see if he could bring one back. Ibn Saud gave him

[2] H. St. J. B. Philby: Southern Najd, *Geogr. Journ.*, Vol. 55, 1920, pp. 161–191 (noted in the *Geogr. Rev.*, Vol. 10, 1920, pp. 347–348); Across Arabia: From the Persian Gulf to the Red Sea, *Geogr. Journ.*, Vol. 56, 1920, pp. 446–468.

26 tribesmen finely mounted, and with these Philby pushed off in November, 1917, to make the first crossing of the peninsula since that made by Captain Sadlier from the Gulf to Medina and Yambo in 1818. He met with both fanatics and fighting tribesmen on his way but won through in remarkably fast time to Taif. Avoiding, of course, Mecca itself he came to Jiddah to meet Husein, and I was sent from Cairo to meet the two in January, 1918. Our long interviews and negotiations, however, led to little result and Philby, not allowed by the old king to return through Hejaz, had to get back to Riadh by making the long circuit by sea. When he returned to Ibn Saud, in the summer of 1918, he found less than ever to do, and he bethought himself of employing his time and experience in penetrating the unknown land of the south towards the Great Desert. Ibn Saud, glad to remove him from his capital, where fanatics growled at a Christian's presence, gave him a strong and trusty escort to fend off the still more exclusive fanatics of the south, where no Christian had ever been seen. Philby met some moments of peril, but he accomplished his purpose; and in a journey of some 300 miles out and 300 home he has solved for us pretty well all the riddles of southern Nejd.

Character of the Heart of Arabia

Thanks to these two journeys we now know that the heart of the great peninsula—an area of, say 75,000 square miles—is not, as had been supposed, one long decline eastwards from a crest running north and south up the western coast, but is divided diagonally into two slopes, one falling towards north-northeast, the other towards south-southeast, and that its main gable ridge runs in a curvilinear direction from a point in the north of Yemen to northern Nejd, about Sedeir. The middle part of this ridge passes through a highland country of igneous formation, whose general level is between 4,000 and 5,000 feet. It has sharp granitic peaks on the divide itself, rising to 6,000 feet and more. The existence of these highlands was previously unknown. There seem to be one subsidiary swell north of the main divide and two to the south of it—making four ridges in all to be crossed by the pilgrim road from Riadh to Mecca.

In the heart of this region lies a district, hitherto unexplored, which is capable of maintaining sparsely settled life. Water, albeit brackish, is apparently procurable everywhere in not very deep wells on the southern side of the divide. Nowhere in its area is there any extensive sandy desert, though the whole is steppe. But it is fenced off on the northwest and the southeast by sand belts, in neither case very broad or taking more than a few hours to cross. It is therefore all good Bedouin country. Philby reports talk of minerals, even gold, in it; and there is the same talk in Hejaz. In any case it is an easily traversable country; and in the light of our new knowledge we can understand both the ease with which the Prophet's arms spread across Nejd into Hasa and Oman in the seventh century and

the equal ease with which Wahabite arms spread to Hejaz and Asir in the nineteenth. We can understand also why Ibn Saud can and does claim territorial solidarity right across to the Hejaz border and how he is able to make that claim good.

Myths Dispelled

Since Philby could see, from the line of his second journey, some of the peaks of these same highlands, we can be sure that in so uniform a land as is this part of central Arabia no important secret lies hid any longer. There are to be reckoned with only the steppe sloping to southeast, the fringing desert, and the features of the oasis land of southern Nejd, down the length of which Philby's second route lay. His Dawasir trip has dispelled myths. The supposed vast habitable region south of Wadi Hanifa has shrunk, together with that great and continuous volume of trade, crossing the peninsula diagonally from Nejran, which so long was credited despite the little show it made at any point of the Gulf shore. In reality all that is capable of maintaining settled life south of Hanifa is a thin strip of alternating oasis and desert, about three hundred miles long in all. What advantages it possesses it owes to a great accumulation of sand on its southeastern edge, which blocks the farther eastward flow of drainage from the central highlands and from the face of Jebel Tuwaiq. This is dammed back as ground water under the districts of Kharj and Aflaj at so high a level that it can be collected into reservoirs by the Persian *khanat* method (*falj*). Even permanent ponds form on the surface. Philby saw at least three groups of these, some of great depth and one having the dimensions of a small mere. A rumor of this last reached French officers of Mehemet Ali's force in Asir nearly a century ago. The southeastward facet of the peninsular pyramid receives much more abundant precipitation than that which slopes to northeastward. Philby's information and observation indicate that its wadis run not infrequently in heavy flood—a fact which explains why Nejdean history shows such ups and downs of civilization and why the House of Saud, with tardy prudence, definitely abandoned valley ground for steppe in choosing the site of its actual capital, Riadh.

The Kharj District

The only desirable part of southern Nejd is a broad isosceles triangle at the northern end of the strip. Here lay the old Yamama. This region, Kharj, has running surface waters capable of fertilizing far more soil than they actually do, and extensive traces of an earlier, more enlightened and more populous society. Exposure to the central government in Riadh seems to have reduced the population of its eastern part; but in the western part the long foothill valley of Hariq, in Jebel Tuwaiq, has been able to protect itself and preserves a large urban settlement, Hauta, and two lesser towns. Hauta, however, is in no sense metropolitan but is just a self-contained, self-feeding oasis settlement, isolated in virtual independence.

The Aflaj District

South of Kharj the strip is continued by the long and narrow depression of Aflaj, of whose few oases Laila occupies the most extensive. Like Kharj, this district seems to be cut off by Tuwaiq from the pastoral life of the center and to be roamed by but few Bedouins. With increasing deterioration this strip is continued and completed by Sulaiyil, beyond which lie the great sands of the Ruba el-Khali. Philby found that a certain amount of caravan trade passed through this latter district to and from Nejran and Yemen; but the trade is on too petty a scale to redeem the settlements of Sulaiyil from their mean status of poverty-stricken hamlets. This is the leanest part of the strip.

Wadi Dawasir

Wadi Dawasir is not part of the continuous strip but lies on the contrary side of Jebel Tuwaiq and on a different drainage channel. This comes right across from the highlands of Asir, being a continuation of Wadi Ranya; and, instead of sending its waters with those of the strip, to the Sabaha depression and the Gulf of Qatar, it empties them directly into the Ruba el-Khali. The establishment of the distinction of these two important hydrographic systems of southern Nejd is the best result of Philby's expedition. He has shown further that Dawasir does not lie on any direct line between Riadh and Yemen and that it is neither so populous nor so primitive as has been supposed. While itself occupied by fairly well organized settlements, it is intimately connected with the pastoral steppes to north of it, includes a large Bedouin element of population, and has a still larger one dependent upon it.

THE REGIONAL GEOGRAPHY OF TURKEY: A REVIEW OF BANSE'S WORK *

By Ellen Churchill Semple

[With separate map, Pl. VI, facing page 350]

Turkey lies at the junction of three continents. It is thrust in between the Mediterranean and the Persian Gulf, between the Black Sea and the Red. It bridges the space between the Balkan Peninsula and Persia, between Persia and Egypt. It is a great isthmian region, dominating the chief intercontinental trade routes of the eastern hemisphere. It flanks for a thousand miles the steamer highway of the Suez Canal and Red Sea. It controls the Dardanelles and the Bosporus leading to the Black Sea lands. It is crossed by old caravan tracks and the future railroad routes connecting the Mediterranean and Black Sea ports with the Persian Gulf coast. It therefore holds a highly strategic position.

By reason of its location, Turkey has drawn the elements of its population from the grasslands of Semitic Arabia, from the highlands of Aryan Persia, from the Caspian plains of Mongolian Asia, from the multifarious race stocks of the Russian Caucasus, from the Greek coasts of the Balkan Peninsula and Aegean Isles. These it has assimilated more or less to the indigenous Hittite or Alarodian race. The peoples comprised within the borders of Turkey differ in racial and geographic origin, in language and religion, in social and economic development. On the other hand they are united by certain common bonds found in the semiarid climate of Turkey, the prevailing steppe vegetation with its concomitant, pastoral-nomadic life, the patchy distribution of the arable land, the sparsity of the population, and finally the deep underlying community of ideals molded by this environment through a process of social development unfolded from within through the ages. To these may be added the religion of Islam and the fanatical devotion of its adherents, who here number five-sixths of the people.

Anatolia, or Asia Minor

The Anatolian Peninsula stretches like a bridge between southwestern Asia and southeastern Europe. It consists of a high plateau, increasing in altitude towards the east, and rimmed on its three seaward sides by young mountains rising boldly from the coast. Structurally and racially it is part of Asia. Its wide steppe interior has been a passway for Asiatic migrations,

* Ewald Banse: Die Türkei: Eine Moderne Geographie. 3rd edit. 454 pp.; map, ills., bibliogr., index. Georg Westermann, Brunswick, 1919. 10 x 6½ inches.

The spelling of place names in this article is for the most part in accord with the Royal Geographical Society's system. On the general question see the note on the Permanent Committee on Geographical Names in the record section of this number of the *Review*.—Edit. Note.

but the massive mountain barriers which trace the northern and southern coasts have excluded oversea immigrants from Europe and thus maintained the Asiatic solidarity of the peninsula. Only the Aegean front, with its deeply embayed coast and its structural valleys opening westward, has been hospitable to Hellenic colonization and European influences.

The rain-bearing winds from the neighboring seas expend their moisture on the outer slopes of the coast ranges (rainfall 600 to 1,000 mm.) and reach the interior impoverished. Hence the plateau core has an arid climate, extensive steppes or saline wastes where nomads pasture their herds, mountains bare or thinly covered by a scrubby growth of trees on the high inland slopes, and shallow U-shaped valleys drained by meager streams which serve to irrigate strips of tillage land along the interior piedmont. The coast ranges get ample precipitation for winter grain crops along their lower slopes, where the typical Mediterranean vegetation prevails, and they have abundant water to irrigate in summer the orchards and gardens of the deltaic plains or valley lowlands at their base. On their upper slopes they support a magnificent belt of forests, which averages 60 miles in breadth and comprises one-third of Anatolia's area.

The Marmara Coast Lands

The Marmara region comprises the indented coast lands encircling the Sea of Marmara and the Straits—namely, eastern Thrace, the Troad, Lesser Phrygia, and Bithynia. It belongs both to the Mediterranean and Pontic climatic provinces and combines the vegetation appropriate to each. Thrace is a Quaternary plain, screened on the north by low mountains which partly fend off the moist winds from the Black Sea and give Thrace a steppe vegetation more suggestive of Asia than of Europe. Cultivated fields and orchards are distributed along its valley floors, especially in the moist lowland of the Maritsa River. The Asiatic half of the Marmara region, owing to the disposition of the mountain ranges in successive tiers well back from the Pontic shore, is accessible to the Black Sea winds and gets ample rain (800 mm.) over most of its area. Agricultural products in great variety—grains, olive oil, wines, linseed, flax, cotton, opium, sesame, and mulberry trees for sericulture—are raised along the seaward slopes, while the valleys in the rain shadow are either cultivated by irrigation or afford pasturage for cattle. Oak and fir forests on the high ranges attest the influence of the Pontic winds.

Constantinople, intercontinental capital, holds the head of the Anatolian bridge and controls the marine highway of the Bosporus.

Northern Anatolia

Pontic Anatolia comprises the northern mountain zone of the peninsula. Its relief consists of steep-sided horsts, dissected into mountain chains, which rise directly from the coast and increase in elevation from west to

east. The rugged littoral has few ports and difficult hinterland connections. The region is distinguished by its Pontic climate, characterized by ample precipitation all year round on the seaward slopes, though west of Samsun the rainfall shows a marked summer minimum. Eastward precipitation increases from 727 millimeters at Samsun to 875 millimeters at Trebizond and 2,500 millimeters at Batum. Behind the mountains it declines rapidly to 400 millimeters on the margin of the interior plateau. Dense forests of conifers and deciduous trees on the rainy seaward slopes support a big lumber industry. Sawmills on the perennial torrents convert the logs into planks, which are exported through Samsun, Sinope, and Trebizond to Mediterranean markets. The subregion of Paphlagonia and the adjacent district of Djanik in eastern Pontus are distinguished by longitudinal valleys near the coast, which contain long bands of settlements and farms, and carry the only roads parallel to the littoral in all this region. Djanik has the only fairly good ports (including Samsun) and the only fertile deltaic plains. Lazistan, a narrow zone of lofty forested mountains stamped with isolation, is crossed by the caravan route from Persia and Armenia to Trebizond, *entrepôt* for a large plateau hinterland.

The Plateau Interior

The central region is characterized above all by its dry plateau character. The rain falls chiefly in spring, when it provides temporary pasturage for the Turcoman and Kurdish nomads. The zone of settlements, dependent upon irrigation streams, is fairly broad in northern Cappadocia and Galatia, where the old folded ranges derive some rain (350 mm.) from the Pontic winds; but it is narrow in the south, where the Taurus rampart excludes the Levantine winds. The desert core of the plateau nearly coincides with the province of Lycaonia, which gets only 200 millimeters of rain annually. In the Konia plain, however, German enterprise in 1912 reclaimed 100,000 acres of land by irrigation works which tapped the Isaurian lakes in the Taurus Mountains. In eastern Cappadocia the great volcanic mass of Mt. Erdjias (13,317 feet) forms a climatic island with a local precipitation of 800 millimeters, chiefly in the form of snow which lingers on the summit late in summer. Its streams irrigate a belt of fields and gardens planted in the tufaceous soil about its base and maintain numerous villages and towns, chief of which is Kaisariya. Phrygia, the western province, is a highland of good pastures and arable valleys because it is fairly accessible to the Aegean winds which here penetrate through gaps into the interior and bring 400 to 500 millimeters of rain.

Western Anatolia

This region embraces the Aegean front of Asia Minor. Its highly articulated coast and its valleys of subsidence extending from the Aegean embayments into the interior have made it hospitable equally to the moist sea

winds and to oversea peoples. The relief is extremely varied. Old folded mountains in the north and south and the Lydian crystalline mass in the middle have all been modified by elevations and subsidences, overlaid in the north and middle by Tertiary deposits and volcanic outflows, and subjected to various degrees of erosion according to the rainfall. The climate is typically Mediterranean, with a summer drought lasting three months in the north and six months in the south. The rainfall, which is 653 millimeters at Smyrna, declines gradually from the coast inland; it is 500 millimeters sixty miles from the sea.

Mysia, exposed to the Pontic rains, has a very dissected relief, which has proved an obstacle to communication and cultural development. The rains nourish large forests of pine, oak, and beech, extending from the coast far into the interior. The late Tertiary deposits provide in general fertile soils; but, owing to difficult communication, the agricultural districts are small and scattered, except in the plain of Pergamum, where the Caicus valley opens a highway from the coast. There the alluvium produces various crops, while the bordering slopes are planted in orchards and vineyards. Lydia, with its ample Tertiary deposits, fertile volcanic soils, and adequate rains, is the land of tillage. Its abundant harbors and long subsidence valleys make it also a land of traffic routes between coast and interior and explain the big export trade of Smyrna. Caria has an infertile soil which neutralizes the advantages of its embayed coast. Only the Meander valley forms a belt of alluvium which flanks the crystalline mountains to the south and produces grains, hemp, cotton, and tobacco. Where the alluvium meets the crystalline rim of the valley are the famous "Smyrna fig" plantations.

Southern Anatolia

This region is traversed by the folded ranges of the Taurus system which extends in a shallow crescent from the Anti-Taurus to central Phrygia. The mountains intercept the rain-bearing winds from the Levantine Sea and therefore have abundant forests on their seaward slopes; but the inner flanks support only pasturage and irrigated patches of tillage land. The climate is typically Mediterranean along the coast; the five months of summer drought is broken only by occasional cloud-bursts. In Lycia the mountains rise directly from the sea. The rugged coast is broken at intervals by little deltaic flats at the heads of protected bays, where population concentrates and cultivates plantations of subtropical fruits. Pamphylia embraces the narrow coastal plain at the head of the Gulf of Adalia. Its villages and farms are distributed along the inner piedmont border, which combines good drainage, fertile soil, and ample irrigation streams for the cultivation of cotton, sugar cane, and various southern fruit plantations. Near the sea a broad zone of swamps and lagoons repels settlement but attracts the Yuruk nomads who pasture their herds in the marsh meadows. The hinterland, Pisidia, is a densely forested mountain region cut by long,

gorgelike valleys which admit the rain-bearing winds far into the interior and open above into the high lake region of Isauria.

Cilicia

This region comprises the big subsidence plain at the head of the Gulf of Mersina, together with the vast semicircular rampart of mountains which enclose both plain and gulf. Located at the inner angle of the Levantine Sea, Cilicia forms a transit land between Anatolia and Syria. It shares in the history and culture of both countries, despite the multiple ranges which enclose it on three sides. These folded ranges, lofty and well forested on their seaward slopes, rise to plateau-like summits in the interior, where reduced rainfall and steppe vegetation restrict tillage but encourage pastoral nomadism. The northern half of the Cilician lowland has been reduced to a peneplain, only 250 feet above the sea, by the erosive action of the streams of the Anti-Taurus. The surface shows a thin sheet of humus overlying a coarse conglomerate. The climate is hot and semiarid, while the deeply incised streams are not available for irrigation. Nomad stock raising prevails here. In contrast, the southern half consists of a fertile alluvial plain built up in a shallow bay and abundantly supplied with typical deltaic streams available for irrigation. It is planted with a great variety of subtropical crops and its well drained portions are sprinkled with towns and villages. The low swampy coast is still unoccupied. The Cilician plain, which was a famous district of production in early Greek and Roman times, has recently been recolonized by Egyptian, Syrian, Cretan, Bulgarian, and Circassian peasants, who have brought 1,000 to 1,200 square miles of its fertile soil under cultivation and dislodged the old Turkish population. The northern or piedmont zone is also in large part arable, but its development must wait for railroads and colonists.

Armenia

Armenia is a high plateau (5,200 to 6,000 feet) located behind the lofty Lazistan ranges and almost barred alike from the rains and the cultural influences emanating from the Black Sea. It is bordered on the south by the Armenian Taurus, which greatly impedes communication with the Mesopotamian plains. It is crossed, east and west, by folds of the Anti-Taurus and Zagros Mountains, which have been disturbed by recent volcanic upheavals and overlaid by vast lava flows, so that the relief of the country is extremely complex. Its valleys are blocked on the east by lofty ranges, whose passes are snow-bound eight months in the year, and they open westward upon high and arid plateaus which form an inhospitable transit land to Anatolia. Armenia is a natural stronghold, giving its possessor a grip upon the surrounding countries. It has always been an object of conquest for neighboring states who wanted it for a border fortress against aggression.

The climate of Armenia is distinguished by the severe snowy winters, which, owing to the altitude, last for six to eight months. Precipitation is confined to winter and spring, except in the extreme north, where the Pontic winds bring occasional summer showers to the plain of Erzerum (6,200 feet). The annual rainfall is 800 to 600 millimeters in the high eastern portion but sinks westward with declining altitude to 500 millimeters and beyond the Euphrates drops to 350 millimeters. Armenia is preeminently a steppe land, because the short summer period warm enough for plant growth is arid both on the mountains and in the valleys. The forests, which are scant and few, are practically confined to the valleys, because the protracted cold and the violent winds of the mountains prevent their growth. Therefore pasture lands are widespread, nomad stock raising prevails, and tillage areas are insignificant except in a few lacustrine expansions of the longitudinal valleys.

The Interior Plateau (Inner Armenia)

This plateau region, despite its elevation, is a subsidence area in relation to the high mountains on its northern and southern borders. Offshoots of the Anti-Taurus folds defining its northern boundary rise to 8,000 or 10,000 feet; they offer, however, fairly easy passes by which the thinly strung villages of the valley of the Frat Su (northern branch of the Euphrates), especially the cities of Erzingan and Erzerum, maintain connection with the plateau towns of eastern Pontus and Russian Armenia and through these with the Black Sea ports.

South of the Frat Su runs the great divide of Armenia which separates this longitudinal valley from the Murad Su. It is a lofty folded system, overlaid in the south and east by volcanic deposits which everywhere level up the inequalities to wide plateau surfaces. Its steep northern front marks the southern limit of the Pontic winds and the northern limit of the Kurds. Its long southern slope is semiarid, covered with sparse summer pastures and affording small lacustrine basins utilized for agriculture. It comprises Dersim, an isolated mountain country north of Kharput, which maintained its independence till 1908; the high level plateau of Bingöl Dagh, inhabited by pastoral Kurds and Armenian villagers, the latter forming one-third of the total population; the Lake Van province, cradle of the Armenian folk, who in this province alone form a majority of the population; and finally the upper Murad province, through which runs the old caravan track from Tabriz to Erzerum, traversing a lacustrine trough along the base of the Aghri Dagh frontier range.

West of the Euphrates the mountain structure of Armenia extends with diminished relief into an undulating plateau which rises westward to the Cappadocian frontier. Its steppes are grazed by the cattle, sheep, and goats of Kurdish and Turcoman nomads. Its few villages are occupied by Turks and sedentary Turcomans.

Southern Armenia

This region comprises the broad belt of folded mountains, formed by the Armenian Taurus and Zagros systems, which separate Inner Armenia from the Mesopotamian depression. This barrier, readily crossed at few points, marks the limit of Semitic expansion from the southern plains; but the peoples of the plateau interior, both Kurds and Armenians, have easily descended through the passes to the fertile Mesopotamian piedmont and there exploited its pastoral and agricultural possibilities.

The Commagene province west of the Euphrates consists of a high plateau core flanked north and south by narrow mountain folds. Its rivers flow through deeply cut transverse valleys to the Euphrates. Steppe vegetation appears after the scant spring rains. Tillage is practically confined to the valleys and base of the mountains, where the Malatia and Marash valleys are centers of dense population and varied agriculture.

The Armenian Taurus, rising steeply from the Murad Su, sends most of its drainage southward. Owing to scant rainfall the slopes are bare or dotted with clumps of dwarf oak. At the southern openings of the narrow valleys are intermittent groups of settlements with small terraced and irrigated fields. Near the lower Murad Su, just above its confluence with the Euphrates, is a productive agricultural plain which supports Kharput and Mesere. South of Lake Van the Taurus meets the yet higher and broader Zagros folds. Thin oak forests dot the slopes up to 6,000 feet. This is a wild, almost impenetrable country inhabited by independent Kurdish tribes who combine a little terrace agriculture with extensive nomadic stock raising.

Mesopotamia

Mesopotamia is a large subsidence basin, surrounded by the Armenian Taurus on the north, the Zagros on the east, and the Syro-Arabian plateau on the west. It slopes from the Tauric piedmont at 3,000 feet down to the Persian Gulf; two-thirds of its area lies below the 1,000-foot contour line. The deltaic lowland of Babylonia, extending from the sea to the inner edge of the alluvium at 300 feet elevation, presents a sharp contrast to upland Mesopotamia, which rests upon a rock foundation. Upland Mesopotamia falls into three natural regions, distinguished from each other by geological structure, relief, and rainfall.

The annual precipitation, which is confined to winter, is meager. Below the 1,000-foot contour it nowhere exceeds 250 millimeters, but it increases to 390 millimeters at Urfa at 1,600 feet and to 490 millimeters at Diarbekr in the Tauric piedmont at 2,035 feet. In the northern piedmont districts rains fall during several months and suffice for winter crops of grain, but drought destroys the harvest every four or five years. Elsewhere irrigation is imperative for all tillage.

Northern Mesopotamia

This region embraces the northern upland and piedmont; it is defined on the south by a line connecting Mosul on the Tigris with Membidj on the Euphrates, which may be taken as the boundary of the well-watered area. The region comprises several subregions. The Upper Tigris district, a Miocene plateau overlaid with basaltic lava, stretches from the foothills of the Taurus on the north to the volcanic mass of the Karadja Dagh on the southwest and the bold scarp of the limestone plateau of Tur Abdin on the south. It has a moderate rainfall (500 to 600 mm.), which is protracted into April, and abundant streams which irrigate fields of rice and cotton, besides extensive orchards, vineyards, and gardens. Agricultural villages are scattered fairly evenly over the district. Cities like Diarbekr and Sert owe their prosperity to their location on important traffic routes, rather than to local production. The Karadja Dagh massif (6,068 feet) and the Tur Abdin plateau (3,300 feet) offer little inducement to tillage, but their reservoirs of winter snow feed the abundant springs and streams which flow southward to form the Khabur River and which irrigate a belt of gardens, orchards, vineyards, and fields stretching along the alluvial piedmont plain. Farther west a limestone subregion of block mountains, 2,400 or 2,700 feet in altitude, gives rise to the Balikh River, whose troughlike valleys support a varied agriculture and a dense population.

Beyond the southward reach of these streams steppe vegetation and Arab nomads hold sway. To the southeast, however, the long, detached range of the Sindjar Mountains rises high enough (4,600 feet is the culminating height) to extract some moisture from the clouds and to support irrigated oases along its base and good pastures on its slopes. This climatic island is the asylum of the semipagan Yezidis.

The population of Northern Mesopotamia consists of Kurds, mingled with intrusive Armenians along the highland border of the region and with sedentary or nomadic Arabs along the southern margin.

Central Mesopotamia, or El Djesireh

This region lies between the northern piedmont and the Babylonian lowland and is distinguished from both of them by its pronounced steppe character and its meager area fit for tillage. Cultivation is restricted to small patches scattered along the valley floor of the Euphrates and its two tributaries, the Khabur and Balikh. The whole region is a flat, arid plain whose vegetation, green only in spring, becomes sparser and shorter-lived from north to south. Shammar Arabs pasture their herds of sheep, camels and horses over the steppe and market their wool products in the border towns of Aleppo, Baghdad, and Mosul.

Eastern Mesopotamia

Eastern Mesopotamia embraces the terraced foreland of the Zagros, crossed by spurs and seamed by snow-fed rivers from the ranges behind.

Tillage land and irrigation streams lie side by side, but their economic development is jeopardized by the raids of mountain Kurds and Arab nomads. The northern province, Assyria, gets enough rain for winter grain crops but applies irrigation to its orchards and gardens. Farms and villages are densely distributed over the triangle between the Tigris and the southern watershed of the Great Zab. This province is the focus of roads leading in all directions—a fact which explains the prosperity of ancient Nineveh and modern Mosul.

The southern foreland, extending from the Great Zab basin to the Diala, is distinguished from the northern province by its greater breadth, its warmer and far drier climate, its predominant steppe area, the necessity of irrigation for all tillage, and the equal division of the country between Kurds in the eastern part and Arabs in the western. Settlements and farms stretch in a narrow belt between two chains of foot hills. Abundant petroleum wells promise wealth in the future.

Southern Mesopotamia, or Babylonia

This region occupies the broad alluvial depression between the foothills of the southern Zagros and the escarpment of the northern Arabian plateau. The soil consists of gravel and sand overlaid with clay, marl, and mud. The level surface and the shallow beds of the rivers which offer conditions for irrigation also permit widespread inundations. About two-thirds of the whole area is under water in the flood season from March to August; an equal amount is dry from October to February.

Northern Babylonia occupies the head of the deltaic lowland. This location, relatively high, insures good town sites and fair drainage while it admits few permanent swamps. The largest tillage district lies between the Tigris and Diala and is watered by canals from the mountain stream. It raises grains, fruits, tobacco, cotton, sesame, rice, and dates. Baghdad, located at the focus of various caravan routes and at the head of steamer navigation on the Tigris, relies both on its trade and its local production. Western Babylonia, divided between swamps and tillage land, has many small villages and several towns along the arms and canals of the Euphrates. In lower Babylonia, a region of widespread swamp, steppe, and saline desert, agriculture is negligible, except in the Shatt-el-Arab district, which forms a band of palm oases along the river and produces the finest dates in the world. These are exported in vast quantities through Basra, the river seaport on the Shatt.

Northeastern and Northern Arabia

The Turkish border region of eastern Arabia forms a transition zone between the plateau interior and the Persian Gulf-Mesopotamian depression. It is an arid steppe inhabited by independent Bedouin tribes, over whom the Porte exercised a shadowy authority definitely overthrown by Ibn Saud of

the southern Nedjd in 1913. The low coast land of El Hasa is supplied with abundant ground water, which drains down from the interior and in many places is reached by shallow wells. Date culture and pearl fisheries form the chief occupation of the people. Persian influences, both ethnic and religious, have permeated the region from the opposite coast.

Syria

Syria comprises the belt of fairly well-watered highlands, located between the Mediterranean and arid Arabia. The grain of the highlands runs north and south and shows four parallel bands of relief and climate: (1) a belt of block mountains or plateaus along the coast, with moderate or ample rainfall according to altitude and location; (2) a long middle rift valley with meager rainfall; (3) an inner highland accessible on its western slope to the rain-bearing winds; (4) a semiarid plateau hinterland. These successive belts of relief and climate appear in the four maritime geographical regions of Syria, which are therefore fundamentally similar, though differentiated in various minor features. The corrugated relief would make Syria a long-drawn barrier were it not for several transverse subsidence troughs which open passways from the coast to the interior. The rainfall, though variable in amount, is everywhere confined to winter. The summer drought is long.

Northern Syria

This region is characterized by a relatively low relief wherein the feature of twin highlands and rift valley is scarcely apparent. The surface is an undulating plateau, adapted to agriculture in the north, owing to the Orontes break in the coast range which admits the rains from the Mediterranean into the interior and gives Aintab an annual precipitation of 560 millimeters. The southern portion has irrigated tillage strips along the streams flowing down from the Kurd Dagh, with grazing land in the interfluvial spaces. Low relief and ready access to the coast make this region a natural transit land between the Mediterranean and the Euphrates.

Steppe Syria

The coast range of Steppe Syria is a dissected horst, rising from the coast in natural terraces which afford excellent conditions for agriculture and sinking steeply to the rift on the east. This valley, drained by the Orontes River, spreads out into cultivated plains about Homs and Hama but narrows sharply towards the north. The eastern mountain range is here supplanted by a dissected plateau too low to cause rain. Therefore tillage is confined to the western part of the region, and the steppe hinterland is correspondingly expanded.

Central Syria

Central Syria consists of the Lebanon Mountains and their hinterland. The region is distinguished by the possession of several mediocre ports; by

the high altitude of both the eastern and western block mountains; by the considerable elevation of the rift valley, which is 3,600 feet at its highest point; and by a rainfall which is heavy on the Mediterranean slope of the Lebanon, considerable in the rift valley and on the western side of the Anti-Lebanon and Hermon, but which suddenly ceases in the rain shadow of this high eastern barrier. Hence tillage, which flourishes to the westward, stops short east of the Anti-Lebanon and Hermon, except where the drainage streams from these create the Damascus oasis in the interior. The coastal belt produces various subtropical fruits, tobacco, cotton, and mulberry trees for sericulture. The Lebanon trough raises grain, mulberry, and olive trees, while gardens, vineyards, and orchards dot the western slope of Mt. Hermon and Anti-Lebanon up to 5,200 feet.

Palestine, or Southern Syria

This region is distinguished from the preceding by the presence of a narrow coastal plain, which is totally lacking in safe harbors; by the lower elevation and plateau form of its eastern and western highlands; and especially by the depression of the rift valley below sea level. Lower elevation, combined with a southern location and proximity to the Arabian Desert, makes Palestine the driest region of Syria.

The western highlands get from 500 to 650 millimeters of rain, which suffices for various winter crops, for olives, and for vineyards. The maritime plain, with only 200 to 400 millimeters of rain, depends upon irrigation; it finds the necessary water in the abundant springs which burst forth at the base of the Judean limestone plateau and in the high ground-water table in the plains of Sharon and Philistia, which is reached by shallow wells. The Jordan valley has a meager rainfall from 400 millimeters in the north to 200 millimeters in the south. The waters of the Jordan itself flow in too deep-sunk a bed to be generally available for irrigation, but patches of land on the old Jordan Lake strands are irrigated from springs and wadis. The eastern highland, with a moderate rainfall (400–600 mm.) only in the northern or Golan district, combines limited tillage with stock raising, sedentary with nomad life, in the Ammon and Moab districts.

Hauran

Hauran is an inland plateau region located between Mt. Hermon and the elongated volcanic mass of Mt. Hauran (5,200 feet), whose streams irrigate a broad belt of fertile country at their base, converting an arid district into the granary and garden of Syria. The Damascene, or Damascus district, occupies a terrace at the eastern base of Anti-Lebanon covered with alluvial deposits and watered by canals from the Barada and Awaj Rivers. It supports eighty villages, with their orchards and gardens, several towns, and the city of Damascus—a border market of the Syrian Desert and focus of

many roads. Southward from Damascus extends the fertile lava plateau of Nukra, or Bashan, watered by ample streams and producing excellent crops of wheat and tobacco on the rich volcanic soil which covers the underlying limestone.

Western Arabia

Syria links Anatolia with the Holy Land of Islam. Western Arabia comprises a belt of territory about 140 miles wide, extending for 1,300 miles along the Red Sea coast, the terraced escarpment, and high rim of the Arabian Plateau. Its profile is everywhere the same—coral reefs and coral strand at the foot of white cliffs; then a strip of desert plain with an occasional group of palms growing at a wadi mouth; beyond this, walls of rock rising in terraces to the plateau rim, 6,000 feet high or more and loftier in the south than in the north. Despite this nearly identical relief, Western Arabia forms two distinct geographical regions, sharply differentiated by their rainfall.

The northern, or subtropical region, includes Midia, Hedjaz, and Asir. Its rainfall, which is confined to winter, is very variable and probably less than 200 millimeters a year. The region is steppe or semidesert given over to pastoral nomadism supplemented by a little irrigation tillage in the scattered oases. The Hedjaz, with its sacred cities of Mecca and Medina, imports all the food consumed by its crowds of pilgrims. Asir, the southern province, located on the margin of the tropical rain belt, has numerous and even extensive oases watered by full winter streams. It raises enough wheat, barley, grapes, and various fruits for its own needs, with a slight margin over for export.

Tropical Arabia, or Yemen, Arabia Felix of the ancients, lies in the belt of the summer monsoons and, by reason of its lofty mountains, which, south of the 14th parallel, are 10,000 feet high, receives 600 to 1,000 millimeters of rain. Precipitation decreases northward, however, and at the 18th parallel is only 250 millimeters. The rains last from May to September. Agriculture is the basis of the economic life. The steep slopes have been terraced for gardens and orchards, fields and vineyards, up to 6,000 feet. Barley, rye, almonds, figs, peaches, apricots, apples, pears, bananas, lemons, plums, and walnuts thrive nearly everywhere. The coastal plains and piedmont produce dates, sesame, cotton, and indigo. Higher up grow wheat, tobacco, and especially coffee. The climatic zones of altitude give rise to active domestic exchanges. The export trade, which is inconsiderable, goes out through Hodeida and Aden.

Behind the rain screen of the mountains in both tropical and subtropical Arabia the picture is the same: a bare plateau, watered by rare winter showers, harbors a few villages in its scattered oases, while Bedouins set up their black tents in the widespread steppe desert. The southern Nedjd with its desert stretches broken by groups of oases in the upland belt of the Tuwaik has been described in the preceding article.

CLASSIFICATION OF THE NATURAL REGIONS OF ASIATIC TURKEY (AFTER BANSE)

Asia Minor (Anatolia)

MARMARA PROVINCE
- Thrace
- The Troad
- Lesser Phrygia
- Bithynia

NORTHERN ANATOLIA
- Paphlagonia
- Eastern Pontus

INNER ANATOLIA
- Cappadocia
- Lycaonia
- Galatia
- Phrygia

WESTERN ANATOLIA
- Mysia
- Lydia

SOUTHERN ANATOLIA
- Lycia
- Pamphylia
- Pisidia
- Isauria
- Highland Cilicia
- Cilician Taurus
- Lowland Cilicia — Cilicia
- Amanus Range
- Anti-Taurus

Armenia

INNER ARMENIA
- Middle Euphrates District
- Erzerum District (transitional)
- Upper Murad District
- Lake Van District
- Bingöl District
- Dersim
- Western District (transitional)

SOUTHERN ARMENIA
- Commagene Taurus
- Armenian Taurus
- Zagros Mountains

Mesopotamia

NORTHERN MESOPOTAMIA
- Upper Tigris District
- Karadja District
- Tur Abdin
- Khabur Headwaters District
- Djebel Sindjar
- Northwestern Limestone District

CENTRAL MESOPOTAMIA (EL DJESIREH)

EASTERN MESOPOTAMIA
- Assyria
- Eastern Scarp District

SOUTHERN MESOPOTAMIA (BABYLONIA)
- Northern Babylonia
- Western Babylonia
- Central and Eastern Babylonia
- Delta District

Syria

NORTHERN SYRIA
- Aleppo Plains
- Kurd Mountains
- Kara Su Trough
- Northern Gateway

STEPPE SYRIA
- Hinterland
- Eastern Border Mountains
- Orontes Valley
- Ansariyeh Mountains
- Nahr-el-Kebir Gateway

CENTRAL SYRIA
- Phoenicia
- Lebanon
- El Bikâa
- Anti-Lebanon
- Hinterland

HAURAN PROVINCE
- The Damascene
- Eastern Basalt District
- The Hauran
- The Ledja
- Nukra Plain

PALESTINE (SOUTHERN SYRIA)
- East Jordan Land
  - Golan
  - Gilead
  - Ammon
  - Moab
- El Ghor
- West Jordan Land
  - Galilee
  - Samaria
  - Judea
- Coastal Plain

Northeastern and Northern Arabia

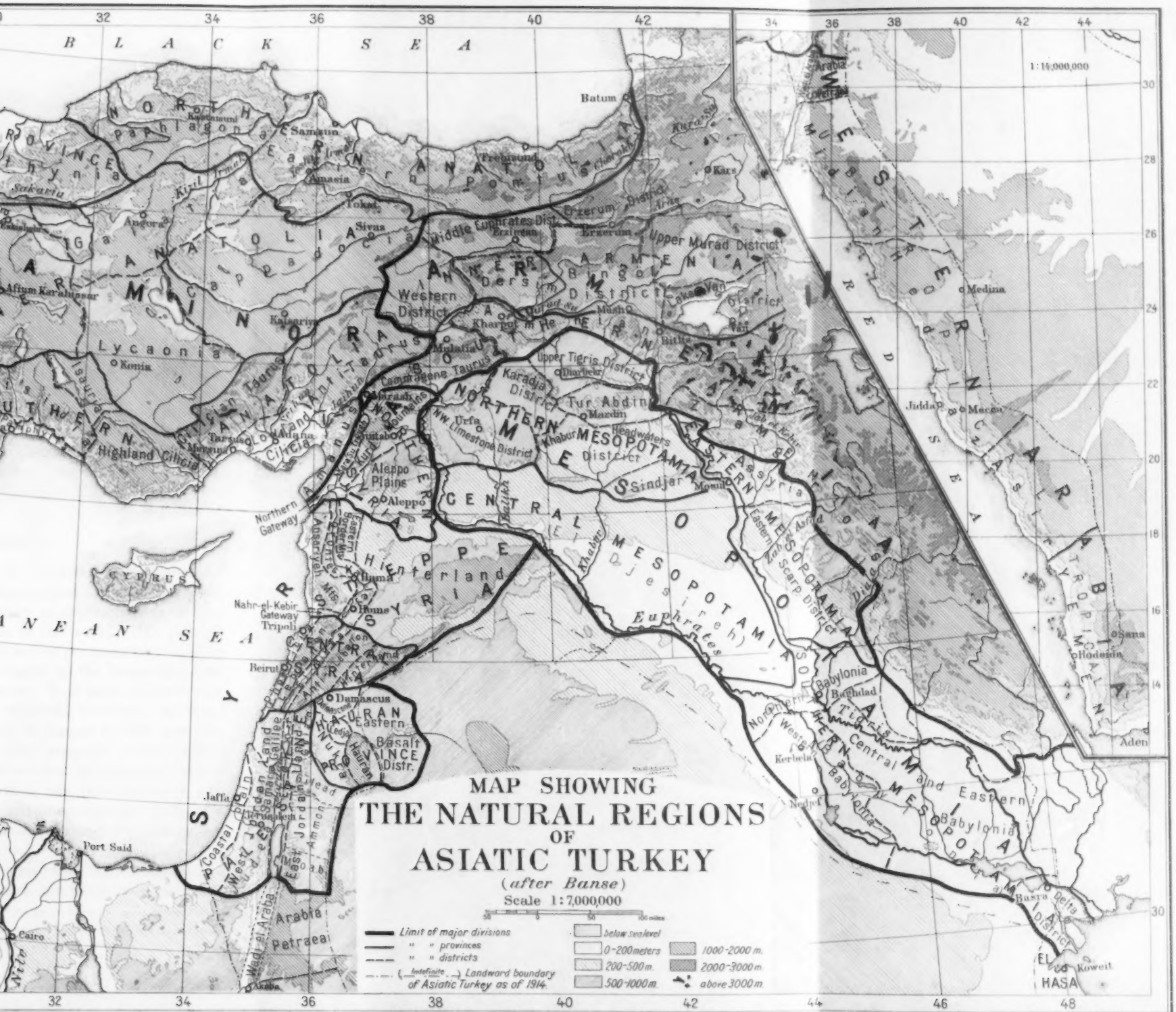
EL HASA

NORTHERN ARABIA

Western Arabia

SUBTROPICAL
- Wadi el Araba
- Arabia Petraea
- Midian
- Hedjaz
- Asir

TROPICAL (YEMEN)



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The Geographical Review, Vol. XI, No. 3, 1921 Plate VI

THE PHYSICAL GEOGRAPHY OF THE SOUTHERN PART OF THE MALAY PENINSULA*

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The term "Malay Peninsula" covers the portion of Asia that forms a continuation of the region where Burma and Siam meet. Unfortunately the term is not precise; the southern end of the Peninsula is clearly defined; on the other hand a difference of opinion exists as to where the Peninsula ends and the Isthmus of Kra begins, both latitude 10° N. and latitude 13° N. having been given recently as the northern limit. The land with which we are concerned in this paper is almost the same as "British Malaya" and comprises the land between latitude 1° 7′ N. and latitude 7° N. In this area there is some Siamese territory to the north-northeast; the remainder, with adjacent islands, is made up of the Straits Settlements (Penang, Province Wellesley, the Dindings, Malacca, and Singapore), the Federated Malay States (Perak, Selangor, Negri Sembilan, and Pahang), and the Protected States (Perlis, Kedah, Kelantan, Trengganu, and Johore).

CLIMATE OF THE PENINSULA

Situated in the warm seas of the tropics and remote enough from the volcanic arc of Sumatra and Java to be untroubled by eruptions and earthquakes, untouched also by the devastation of typhoons, the Malay Peninsula is one of the most favored corners of the world. The rainfall is heavy, varying from about 80 inches to 160 inches per annum, according to the position of the recording station with regard to the mountains, and is distributed fairly equally throughout the year. It is often claimed that seasons can be recognized; but a study of statistics convinces me that, south of Kedah at any rate, the only division of seasons is that once put forward by a wit who remarked that one might recognize a "wet" and a "wetter" season. September, October, and November are generally wetter than the rest of the year; but it does not often rain before noon in any month. There is an abundance of sunshine, and sometimes dry spells of a fortnight or so occur. In Kedah and northwards wet and dry seasons are recognizable.

The heat is not great. The average daily maximum shade temperature is 88° F., and I believe that 100° F. in the shade has never been recorded.

* I am indebted to Mr. C. Boden Kloss, Acting Director of Museums, F. M. S., for suggestions in connection with this paper and for the loan of photographs of Gunong Tahan.

The nights are cool enough for comfortable sleep. But, while the actual thermometer readings are low compared with those in some other countries, the daily maxima and minima vary little throughout the year, and the air is laden with moisture. There is no cold season. On the low ground the thermometer occasionally drops below 70° F. at night; at an altitude of 7,160 feet I have seen it drop to 54°; but after much experience in various stations I think that a range of 70° to 88° F. throughout the year expresses the general shade temperature of the country, including the night.

On the east coast the northeast monsoon blows fairly strongly between November and March; on the west the force of the southwest monsoon is broken by Sumatra. Generally speaking, day breaks on a perfectly still atmosphere; then a light breeze springs up and may increase to a stiff breeze later. Squalls occur sometimes that do local damage.

The Soil, Vegetation, and Scenery

The warm, moist climate has attacked the surface rocks and formed soils that support a luxuriant vegetation. Before man made clearings nearly the whole country was covered with jungle dense enough to shut out a view of anything beyond a hundred yards. Big game hunters state that in virgin jungle forty yards is the usual range at which they get a shot. The abundant rainfall, however, has created a network of rivers where one can see nature at the height of tropical beauty. No artist has yet done full justice to our Malayan rivers, flanked by giant trees of varied hues of green, gray, and brown; sometimes meeting overhead to form a shady avenue along which one can drift downstream for miles; now tumbling over rapids, now flowing peacefully through Malay villages to the beautiful east coast with its sandy beaches, bright sunshine, and fringe of *Casuarinas*—beaches that contrast favorably with the muddy, crocodile-infested mangrove swamps of the west coast, where sandy beaches are not so easy to find. On some of the highest peaks of the mountain ranges the vegetation thins sufficiently to enable one to enjoy to the full, without cutting down trees, an extensive view of billowing, jungle-covered country; and on the highlands below the summit of Tahan (7,188 feet) one can walk over open spaces at about 5,000 feet where a very poor soil and the northeast monsoon have checked the growth of everything but low scrub (see Figs. 6 and 7).

In addition to fertile soils, the Peninsula has mineral wealth. Few lands have been so well endowed by nature; but on the other side of the account we find tropical diseases, the gradual sapping of energy by the constant moist heat, and numerous flying and crawling things that bite and sting. Nevertheless, many persons manage to live here, with occasional holidays in a cold climate, for the greater part of their working lives; few, if any, escape being infected with malaria; but nowadays deaths from it among white people are rare.

Biogeographical Indications of Land Movements in the Peninsula

Before describing the present configuration of the Peninsula I will sketch very briefly the opinions generally held by biologists concerning the effect of land movements in the Peninsula and Archipelago relative to sea level, as indicated by the distribution of fauna and flora.

This area was the scene of Dr. Alfred Russel Wallace's classic work, and to him we are chiefly indebted for the elucidation of the problems of distribution.

In 1896 Mr. R. Lydekker quoted Dr. Wallace's views accepting his conclusion as "on the whole, a very probable explanation of the facts of the case."[1] Without entering into the biological evidence, Dr. Wallace's opinion was as follows:

> [In Miocene times] Java would have been at least three thousand feet lower than it is now, and such a depression would probably extend to considerable parts of Sumatra and Borneo, so as to reduce them all to a few small islands. At some later period a gradual elevation occurred which ultimately united the whole of the islands with the continent. . . . Java was then separated by subsidence. . . . A little later the subsidence may have extended farther north, isolating Borneo and Sumatra, but probably leaving the Malay Peninsula as a ridge between them as far as the islands of Banca and Biliton. Other slight changes of climate followed, when a further subsidence separated these last-named islands from the Malay Peninsula[2] . . .

More recent work has thrown further light on this subject. Thus Mr. H. C. Robinson says:

> It is therefore, I think, fairly evident that at some comparatively recent time a barrier has existed between the mountains of Southern Selangor and their continuation in Negri Sembilan, sufficient to prevent the extension of the dominant continental and Sumatran forms southwards. It is evident, also, that this barrier must have been a substantial one, as wide stretches of low country separating the Gunong Tahan Ranges from the backbone of the Peninsula have not sufficed to effect any specific differentiation in the fauna of the two ranges.[3]

Again, Mr. H. N. Ridley in 1916 wrote, concerning the flora of Kedah Peak, that it resembled that of Mt. Ophir,

> especially in the occurrence of lowland seashore plants, isolated as they are from the ordinary habitats of these plants by the forest that lies between them and the sea. . . . There can be little doubt that Mount Ophir was at one time an island detached from the mainland as Penang is to this day, and it seems highly probable that Kedah Peak may have been similarly isolated.[4]

More recently Mr. C. Boden Kloss writes:

> The northern limit of the true Malaysian flora, which covers the southern half of the Malay Peninsula, Sumatra, Borneo and—to a less extent—Java, and of which the conti-

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[1] R. Lydekker: A Geographical History of Mammals, Cambridge, 1896, pp. 302, 303.

[2] A. R. Wallace: Island Life, New York, 1881, pp. 353–354.

[3] H. C. Robinson: A List of a Small Collection of Mammals and Birds from the Mountains of Ulu Langat, Selangor, *Journ. Federated Malay States Museums*, Vol. 4, 1909–11, pp. 235–241; reference on p. 241. Kuala Lumpur.

[4] *Ibid.*, Vol. 7, 1916, p. 37.

nental section may be called Malayan, seems to be a line joining the towns of Alor Star (in Kedah) and Singgora (at the entrance to the Inland Sea).

Botanical features confirm what geological investigations indicate—that this boundary was the coast line of what was once an island but what has since become the southern half of the Malay Peninsula.[5]

I would call this Alor Star-Singgora line a major transverse break in the Malay Peninsula and am inclined to think that there is another between Bandon and Pangnga, and perhaps Bandon and Trang.

These opinions indicate that the "further subsidence" mentioned by Wallace as separating Banka and Billiton from the Peninsula, may have gone farther than was necessary to produce the present configuration. I am convinced that was so and that the subsidence continued sufficiently to reduce the southern part, at any rate, of the Peninsula to a group of islands, that is part of the Archipelago. We know from raised beaches that there has been a very recent elevatory movement. I will give my reasons later for considering the final movements were (1) subsidence, reducing the Peninsula to a group of islands; (2) elevation, probably continuing today, that brought the Peninsula to its present condition.

Summarizing this period of land movements then, we have:

1. The elevation of a group of small islands scattered over a wide area, on the present site of the Archipelago and Peninsula, to form part of the mainland of Asia.
2. The separation of Java by subsidence.
3. The separation of Borneo and Sumatra by subsidence.
4. The separation of Banka and Billiton from the Peninsula.
5. Submergence of a large part of, if not all, the Peninsula to form a group of islands.
6. Elevation of these islands to re-form the Peninsula.

Coulisses

The Malay Peninsula is but a small part of a large region that is thus described by Suess:

In this way the mighty swell of the Altaides in Thibet subsides and is dispersed. The whole continent becomes lower. Many coulisses disappear. Only a few long branches are continued: on the east into the cordillera of Annam; on the west, always giving rise to fresh coulisses, through the Malay Peninsula, and still further, to Java and beyond.

We have now arrived at one of the most instructive parts of the earth's surface. Four elements combine to form it: the end of the Burman arc, the southern branches of the virgation of the Philippines, the spurs of the great cordillera of New Guinea, and finally the continent of Australia, with the cordillera which marks its eastern border and crosses Torres Strait.[6]

The word "coulisse" here means prominent features arranged *en échelon* on the earth's surface like the wings of the stage in a theatre. Such features

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[5] *Ibid.*, Vol. 10, Part II, 1920, p. 79.

[6] Eduard Suess: The Face of the Earth, Engl. transl., Oxford, 1908; reference in Vol. 3, pp. 231–232.

are formed by folding of the stratified rocks and the intrusion of masses of igneous rocks, followed by erosion.

Suess describes a granite coulisse as becoming the Lakawn Range, entering the Peninsula and thence onwards representing its axis. This description was based on material collected when little was known of the Peninsula; and one object of this paper is to show how the Lakawn, or Nakawn, Range is succeeded by several other coulisses *en échelon*, which

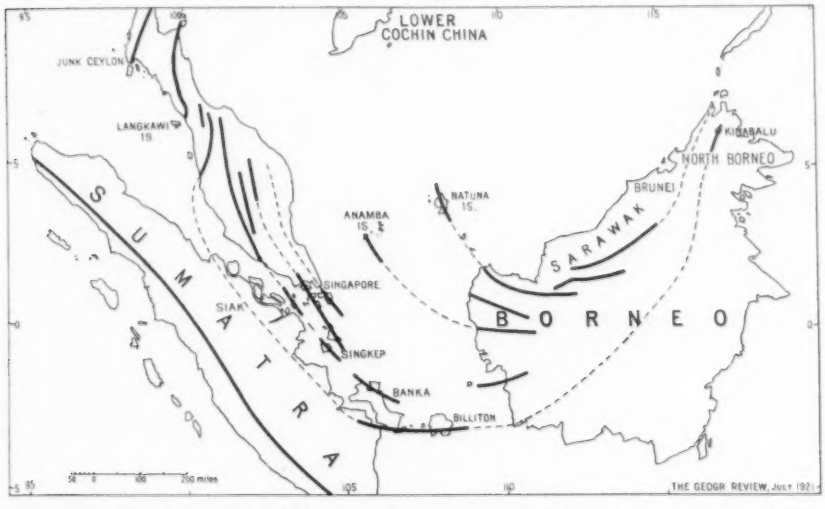


FIG. 1—Sketch map showing the probable connection of "coulisses" in the Malay Peninsula and Archipelago.

together form the skeleton of the Peninsula as defined above, and to trace the probable continuations of these coulisses into the Archipelago where they join coulisses described recently by Mr. Van Es.[7]

NAKAWN COULISSE

The maps, Figures 2 and 3, show in some detail the main features of British Malaya, but before discussing them I would refer to the smaller map, Figure 1 on p. 355, for a moment. In the part of the continent north of the Langkawi Islands two coulisses are marked, the westerly one ending near Junk Ceylon, the easterly being, in the central portion at any rate, the Nakawn Range, which Suess described as entering the Peninsula and representing its axis. Field work in Perlis has given me some knowledge of the southern part of this coulisse, and I have good reason for believing that its true course is as represented; that is, on reaching Perlis, it bends slightly to the west of south and reaches the sea near the Langkawi Islands.

[7] L. J. C. Van Es: De tektoniek van de westelijke helft van den Oost-Indischen Archipel, *Jaarboek van het Mijnwezen in Nederl. Oost-Indië*, Vol. 46, Part II, 1917, pp. 5–143. The Hague.

Turning to Figure 2 we see the termination of this coulisse on a larger scale (No. 1). It forms the boundary between Perlis and Setul. In the north of Perlis granite occurs in it, but elsewhere this boundary range

FIG. 2—Key map of British Malaya showing coulisses. The coulisses are represented diagrammatically by bands of shading. They are not in every case continuous mountain ranges (compare Fig. 3 opposite). References to numbers are: (1) Nakawn Coulisse, (2) Kedah-Singgora Coulisse, (3) Gunong Perak, (4) Kedak Peak, (5) Penang, (6) Granite hills of Province Wellesley, (7) Bintang Coulisse, (8) Kledang Coulisse, (9) Kerbau Coulisse, (10) Benom Coulisse, (11) Mt. Ophir, (12, 13) Tahan Coulisse, (14, 16) East Coast Coulisse, (15) Blumut Range.

consists of rugged limestone hills, which one finds again on the east coast of Langkawi Island, the center of the island being granite. I have climbed hills on and near the northern border of Perlis between coulisses 1 and 2

to search for any continuation of this Nakawn Range into the Malay States to the southeast; but, although it should be plainly visible, I could not see one. Through the supposed site of it a railway has been constructed

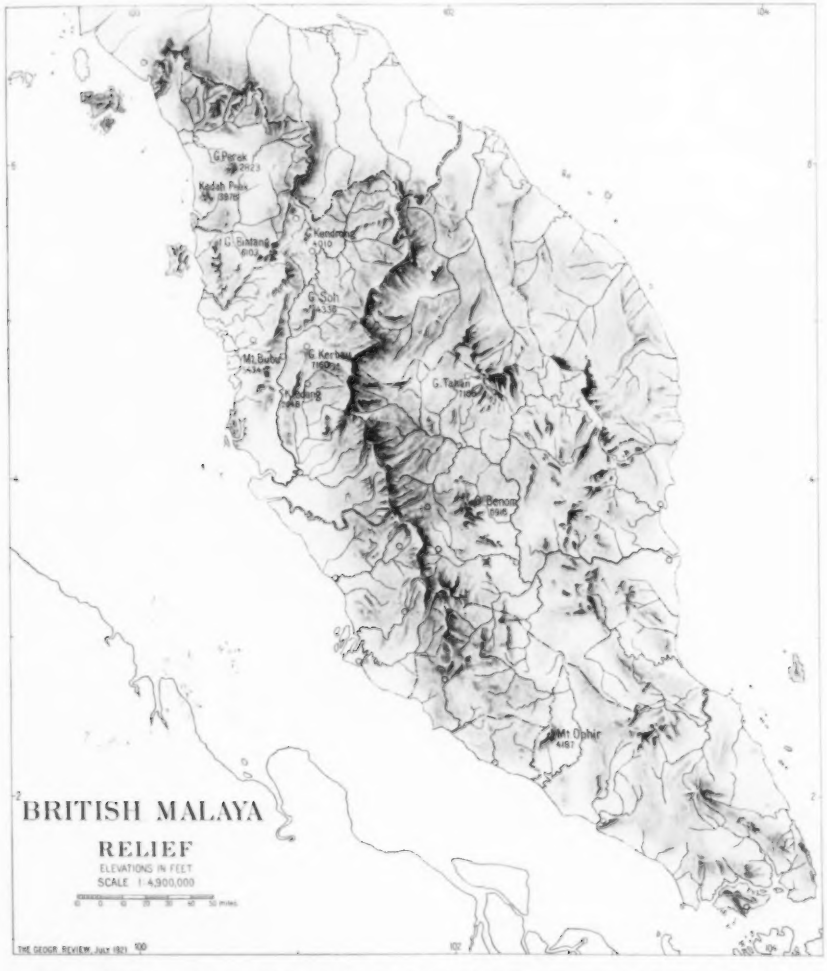


FIG. 3—Relief map of British Malaya based on the F. M. S. Government Survey Map of 1913. For locations and river names see the map opposite, Figure 2.

without difficulty, not to mention an earth road; while the watershed between Perlis and the Siamese territory to the north is for a large part only about 300 feet high. My own observations are corroborated by others who have been farther into Siamese territory than I have. There can be no question that the Nakawn Range does not enter the Peninsula as its

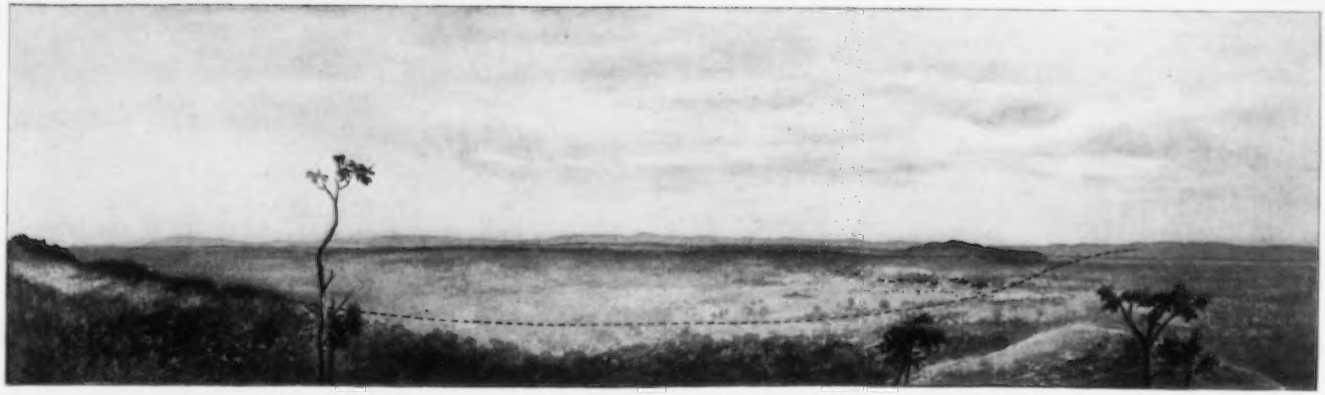


FIG. 4

FIG. 5

FIG. 4—Sketch from a photograph, looking eastward, showing the low watershed between the state of Perlis and Siamese territory. The dotted line indicate the approximate position of the watershed. Padang Besar, a railway station on the border is seen in the middle distance. The range of hills in the far distance is the Kedah-Singgora Coulisse.

FIG. 5—Sketch from a photograph, looking north, showing the low watershed between the Plus and Kinta Rivers. The Plus flows from the distant hills on the right through the cloud-filled gap between the Kledang Range and Gunong Soh. The Kinta River flows through the gap between limestone hills 2 and 3 towards the left of the sketch.

axis, but the statement that it does so will die hard and will probably be quoted for many years to come among those who do not know the ground.

Kedah-Singgora Coulisse

The land between the end of the Nakawn Coulisse and the Kedah-Singgora Coulisse (2) is low-lying. In Perlis and Kedah it is extensively cultivated for paddy, and from the broad stretches of the rice fields isolated limestone hills rise abruptly. In Perlis these limestone hills form a double chain stretching through the center of the state, the first being about eleven miles inland from the present coast. Other limestone hills are found in Kedah, at Kohdiang, and near Alor Star where Elephant Hill is a well-known feature in the landscape.

The Kedah-Singgora Coulisse is formed of hills rising above 2,000 feet and composed chiefly of quartzite and shale. At least one granite outcrop is known. Almost due south of its southern termination is an isolated mountain (3), Gunong Perak; and to the southwest of this again is Kedah Peak (4), or Gunong Jerai, another isolated mountain, 3,978 feet high and composed of quartzite with granitic intrusions. On the eastern border of Province Wellesley are small granite hills (6). Penang Island (5) also is granite.

Bintang Coulisse

East of the Kedah-Singgora Range the boundary of Kedah and Siamese territory is hilly, but the peaks are highest where the border turns sharply southwards. Their composition is unknown to me; but southwards and across the headwaters of the Muda River they are continued as the first large and purely granite range in British Malaya (7). It contains two fine peaks, Bintang (6,103 feet) and Bubu (5,434 feet). I propose to call this the Bintang Coulisse. South of Taiping these granite hills break down for a space and then reappear in the Dindings and Pulau Sembilan (Nine Islands). West of Pulau Sembilan is another granite island, Jarak, which I have recently visited. East of the Bintang Coulisse is the Perak River valley in British territory and, in Siamese territory, the River Patani. The watershed between these rivers close to the Bintang Coulisse is only a little over 1,000 feet. Grik, close to the Perak River, is only 380 feet above mean sea level, but the country through which the river flows until it reaches Kuala Kangsar is all hilly and affords some of the finest tropical scenery imaginable. The hills are of quartzite and limestone lying on a granite platform, but close to the river is a well-marked granite range (8), cut through by the Plus north of Sungei Siput, in which the best-known peak is Kledang near Ipoh (2,846 feet). The highest, however, is Gunong Soh (4,336 feet) north of the Plus. The granite of this range is covered by quartzite in the southern part.

mate position of the watershed. Padang Besar, a railway station on the [illegible]

Fig. 5.—Sketch from a photograph, looking north, showing the low watershed between the Plus and Kinta Rivers. The Plus flows from the distant hills on the right through the cloud-filled gap between the Kledang Range and Gunong Soh. The Kinta River flows through the gap between limestone hills 2 and 3 towards the left of the sketch.

Kerbau Coulisse

To the east of the Perak River is the Main Range (9), or Kerbau Coulisse (Gunong Kerbau, 7,160 feet), formed of granite with some sedimentary rocks high up among the granite hills. This range is the most striking feature of the Peninsula and has five peaks over 7,000 feet grouped near the Kelantan-Pahang border. The mountains decrease in height as one follows them south until they die away in Malacca.

Although I have been nearly to the headwaters of the Perak, I know very little of the northern end of this range. From a hill at Intan, north of Grik, I have looked down the broad Patani valley and can only say that the Main Range must end somewhere between the Patani and Telubin Rivers in Siamese territory.

Between the Main Range and the Kledang Coulisse (8), the watershed between the Plus and Kinta Rivers is very low (271 feet). To the south of Ipoh rolling country merges into an extensive alluvial flat extending along the coast as far as Negri Sembilan, from which rise here and there little hills of quartzite and granite. Nearer the Main Range is an extensive belt of low quartzite hills not indicated on Figure 1.

Benom Coulisse

To the east of the Main Range, which is distinctly ex-centric in its position, lies the greater but less developed part of British Malaya. Two metalled roads, from Kuala Kubu and Kuala Lumpur, enable one to travel easily over the Main Range into Pahang. Flanking the granite hills on the east is a much lower range of quartzite foothills near Raub and Bentong, and east again of these is a belt of comparatively low-lying country, composed chiefly of calcareous rocks, which terminates abruptly against the Benom Coulisse (10) in which Benom is the only high mountain (6,916 feet), situated between the Jelai and Semantan Rivers. This coulisse also is granitic but rich in hornblende. Northwards its continuation is marked by inconspicuous granite outcrops. To the south the Semantan cuts through rocks found in the Benom massif, while there are further outcrops extending into Negri Sembilan. Mt. Ophir (11), 4,187 feet high, may be a prolongation of the Benom granite, and the same may be true of granite hills near Kuala Pahat; but the separation of these outcrops from the Kerbau Coulisse in Negri Sembilan and Malacca is open to question.

Tahan and East-Coast Coulisses

On the east of the Benom Coulisse, and separated from it by the Pahang River valley, is the Tahan Coulisse (12). On the Kelantan border this is marked by the highest mountain in the Peninsula, Gunong Tahan (7,186 feet) It is of quartzite and altered shaley rocks which are continued southwards as a well-marked belt, rising, however, to no great altitude. South

FIG. 6

FIG. 7

FIG. 6—Gunong Tahan (7,188 feet) from an altitude of about 5,000 feet. (Photograph by C. Boden Kloss.)

FIG. 7—Cliffs near Gunong Tahan. This and Figure 6 show the open nature of the country here at an altitude of about 5,000 feet. A poor soil and the northeast monsoon have checked the growth of the usual luxuriant vegetation. (Photograph by C. Boden Kloss.)

of the Pahang River little is known about this belt, but granite and quartzite extending into Singapore Island appear to mark an extension of the coulisse (13).

To the east of the Tahan Coulisse again is one still more indefinite in its southern portion. This (14), the East-Coast Coulisse, is known in the north as a broad tract containing high mountains, believed to be mainly of granite. Detached granite and perhaps quartzite hills in South Pahang and Johore (15 and 16) mark its probable extension. This coulisse contains several areas of tin-bearing granite, and it is a reasonable conjecture that here denudation has laid bare the highest portion of a long tin-bearing granite ridge similar to the granite of the Main Range. Both 12 and 14 extend northwards farther than is indicated on the map, but I have no first-hand knowledge of them beyond the points marked. On the River Tekai quartzite hills, which are regarded as part of the Tahan Coulisse, are a well-marked feature; and in the headwaters of the Tembeling River the country between the Tahan and East-Coast Coulisses is also hilly.

Harmonious Structure of the Archipelago and Mainland

The Benom Coulisse is well marked between the Semantan and Jelai in Pahang, and the Kerbau and Bintang Coulisses to the west are well marked over almost the whole of their course; but the same cannot be claimed for the Tahan and East-Coast Coulisses. When we turn to the Archipelago, however, we find strong support for the courses indicated. In his recent paper Mr. Van Es, working, I believe, without any knowledge of the details of Peninsular geography, traced on a map of the western part of the Netherlands Indies the coulisses revealed by the study of its natural features. These are reproduced on a small scale in Figure 3, on which I have also indicated the Peninsular coulisses. Thus a coulisse in the islands southeast of Singapore carries on the line suggested for the East-Coast Coulisse. Another, with a longer course, prolongs the line of the Tahan Coulisse. The coulisse passing through Singkep and the north of Banka, if produced, joins on to the Kerbau Coulisse, or Main Range. The Bintang Coulisse may, without violating the harmony of the general structure of this large area, be connected, through the Aroa Islands (see Fig. 1), where quartzite is known, to the great sweeping curve of the coulisse that Mr. Van Es marks as passing Siak, the south of Banka, Billiton, the center of Borneo and ending in North Borneo a little beyond the great granite mountain Kinabalu (13,698 feet). It will be noted that the curve suggested for this coulisse through the Straits of Malacca is harmonious with the curve of the Kerbau Coulisse. I doubt if two independent workers could have more striking confirmation of their ideas than that afforded by the manner in which the coulisses I believe to exist in the Peninsula join up with those Mr. Van Es believes to exist in the western part of the Archipelago.

General Character of the Peninsula

These coulisses form the framework of the Peninsula: they mark the lines along which rocks have been folded, hardened, and altered by intrusive igneous masses. An observant traveler, however, will first notice a general feature of the geography, which is that the Peninsula is for the most part a low-lying tract of land from which mountain ranges and isolated hills rise abruptly. How low the general surface of the land is can be gathered from the fact that Raub, close to the Main Range and between the headwaters of the Semantan and Lipis Rivers, these being tributaries far up the Pahang River, is only 462 feet above sea level; Bentong, to the south of Raub, only 321 feet; and Grik, far up the Perak River, 380 feet.

He would notice, too, the extraordinary course of the Pahang River and one of its tributaries, the Tembeling. The latter rises in the East-Coast Coulisse and flows to the west. It then turns south to join the Pahang which continues the southerly course for some way and then, turning sharply through more than a right angle, cuts through low quartzite hills of the Tahan Coulisse and flows eastward to the China Sea.

Moreover, if he were to follow up the Bera and Serting from this sharp bend in the Pahang, he would pass over very low country into Negri Sembilan; it is possible to convey a native boat without much difficulty from a tributary of the Serting overland into a tributary of the Muar and so reach the Straits of Malacca, the watershed between the Serting and Muar being inconspicuous. The actual height of the watershed is given by Mr. T. A. Kitching, of the Federated Malay States Survey Department, as 180 feet. A slight depression, therefore, in Negri Sembilan would divert the Pahang from its present course into the Straits of Malacca approximately along the present line of the Muar.

The Rivers

It is on the rivers that one can best enjoy the beautiful scenery of the Peninsula. The two chief rivers, the Pahang and Perak, vie with each other in this respect. The Pahang is perhaps the more beautiful in its lower reaches, broad and shallow, studded with sandy islands. The Perak excels in its upper reaches, flanked by virgin jungle, full of rapids, narrow, and tumultuous. The Pahang is navigable far above Kuala Lipis; but in the Tembeling and the headwaters of other tributaries there are bad rapids.

Owing to the steep rise of the mountains from the lower land the profiles of the rivers flowing down from them form sharp curves. In the hills the grade is of course steep, and there is little opportunity of depositing the load of detritus. On reaching the foot of the hills, however, the grade suddenly decreases, and detritus is deposited to form alluvial flats.

FIG. 8—The luxuriant Malayan vegetation. A road through quartzite hills in Pahang.

The Granite Hills

There are three distinct types of hills: granite, quartzite, and limestone. The granite hills are not confined to the coulisses shown on the map. Thus between 6 and 7 there are granite hills; and also between 7 and 9, to the east of Grik. There is evidence that in Kedah and the north of Perak the main mass of granite to which the granite coulisses are connected comes very close to the surface and that the covering of bedded rocks is consequently thin. The main mass of granite seems to lie deeper, however, east of the Kerbau Coulisse: I have suggested above that the East-Coast Coulisse may mark the summits of a granite ridge like the Kerbau Coulisse, but only just laid bare by denudation.

In Selangor there are two isolated granite hills that are now familiar landmarks: one, with an old Dutch fort crowning it, at Kuala Selangor; the other at Jugra, Parcellar Hill. It is perhaps worth noting that if the line of the Kledang Coulisse (8) is produced so as to curve in the same way as the Kerbau Coulisse (9), it will pass near these two hills.

The depth to which the granite weathers to a soft sandy clay and possibly other causes lead to the outlines of the granite hills being, for the most part, smoothly curved: precipices are rare, and even at altitudes over 6,000 feet the vegetation is luxuriant, so much so that one rarely obtains an extended view without felling trees. Most of the high granite peaks (the actual summit of Kerbau, I should mention, is formed of sedimentary rocks, not granite) have been cleared at one time or another for surveying purposes and have become covered again with a growth of secondary jungle, which is much worse to penetrate than virgin jungle and quite impossible to see through.

A noteworthy feature of the granite hills is the manner in which parts of the rock resist weathering and form "core boulders" that have the appearance of being waterworn. They are sometimes of great size, large enough to allow men to camp under a projecting side.

Quartzite Hills

The quartzite mountains that I have ascended are Tahan, 7,186 feet; Kendrong (close to Grik), 4,010 feet; Kedah Peak, 3,978 feet; and Bongko, a little east of Benom in Pahang, 2,860 feet. Although the vegetation makes the ascent of any mountain here an easy matter compared with what it would be were there no tree trunks, branches, and roots to pull oneself up by, I know from experience that the quartzite mountains are less easy to ascend than the granite. Bedding and jointing in the rock make precipices of frequent occurrence. On the summit of Kedah Peak there is one that must be over a thousand feet high. Below the summit of Tahan the Tiku River flows through a precipitous gorge that might be called a canyon. Kendrong, which rises from country only about 500 feet high, is steeper than anything else I have climbed

and would, I think, be impossible to all but practiced mountaineers, were it not for the vegetation.

In the northwestern corner of Langkawi Island there is a long junction between granite and quartzite. The latter has withstood weathering better than the granite and now forms a long serrated ridge with peaks over 2,000 feet high and precipices facing towards the granite, which does not rise to the same height.

Limestone Hills

Limestone hills occur in the Langkawi Islands, Perlis, Kedah, Perak, Selangor, Pahang, and I have seen some in Kelantan from the Pahang border. There are none in Negri Sembilan or Malacca; concerning Trengganu and Johore in this respect I have no information. On the mainland they are best developed in Perlis and the Kinta District of Perak. In Kinta they cover a considerable acreage; but both there and in other parts one finds isolated hills rising sharply from the surrounding country, often bounded by vertical or even overhanging cliffs.

When traveling by train through Perak one obtains a good view of the Kinta limestone hills and also of Gunong Pondok, an isolated hill between Kuala Kangsar and Taiping. This hill is 1,860 feet; in Kinta, Nasi Sehabat is 2,005 feet. Sinyum, one of the isolated hills in Pahang not far from Temerloh on the Pahang River, is 1,595 feet.

The boundary range between Perlis and Setul, as already mentioned, is limestone.

In the Langkawi Islands white limestone cliffs and islets of limestone with perpendicular sides undercut by the sea, rise out of the water just as they rise from low ground on the mainland. Were Perlis and the Kinta District flooded by an invasion of the sea the type of scenery would be identical with that of the Langkawi Islands.

As would be expected in this warm and rainy country, the limestone hills are honeycombed with caves, some of great size and beauty. Enclosed hollows shut in by high cliffs also occur. In Perlis such a hollow is known as a "wang." One of them, Wang Tangga (the Ladder Wang—so called because it is entered by a steep climb up steps on one side of a limestone cliff and an equally steep descent on the other), is large enough to contain a Malay village with paddy fields. Some of the caves in Perlis and Kinta contain payable deposits of tin ore. In Selangor one long, dark cave contains a very interesting but uncanny fauna, including large toads, spiders, and white snakes. The last are said to be harmless and only a bleached variety of a common non-venomous snake; but a friend of mine who was bitten by one was laid up for a fortnight with blood poisoning.

Evidence of a Marked Subsidence

The above description of the main features of the Peninsula is very brief and, I fear, unsatisfactory, because necessarily incomplete. There are

enough data, however, to justify our inquiring if any connection can be traced between the present-day features and the succession of earth movements detailed earlier in this paper.

FIG. 9—A limestone cliff in the Kinta District. The distant range is the Kledang Coulisse with limestone hills at its foot.

In the first place, are the existing rivers responsible for the contrast of low-lying land and high ranges and isolated hills rising abruptly from it? To take a particular case, if this is so, then the Kinta River, an insignificant stream, has carved out a huge trough to within 300 feet of sea level between the Kledang Coulisse (Kledang 2,846 feet) and the Kerbau Coulisse (Kerbau 7,160 feet). This I cannot regard as likely. It is perhaps impossible to prove anything, but I will suggest what the course of events may have been.

The high ranges show evidence of great denudation; and, if we assume that that denudation began when the Archipelago was joined to the mainland and the whole surface was higher than it is now, we have a sufficient time interval in which the denudation could be effected. In other words, these ranges and hills are not modern features of a peninsula, but relics of the time when the Archipelago and the Peninsula were one and the river system was more powerful than now. On that mainland the present site of the Peninsula would be a wild mountainous tract, higher than now, where the river system began the work of carving out the hollows between the coulisses.

But when the subsidence set in marine denudation came into play and at the extreme limit of this movement, i. e. when the Peninsula itself was separated as a group of islands from the mainland of Asia, would have planed down a large part of the valleys formed by the old continental rivers. A depression of 500 feet below the present sea level would cover a very large part of the existing land. Grik would be under the sea; the part of the Kledang Coulisse between the Plus and Telok Anson would be an island. The Pahang River valley, Raub, and Bentong would be submerged. The granite, quartzite, and limestone hills would form a multitude of islands and islets. The biological evidence is strong enough for us to assume some such marked subsidence took place.

Results of Marine Denudation

When the elevatory movement that was to restore the Peninsula set in again, the old continental valleys would have been to a large extent modified by marine denudation, and the new drainage system would flow over the remnants of the continental ranges, such parts of the continental valleys as had not been submerged, and a plain of marine denudation. The remnants of the continental ranges have been described. The headwaters of the Perak River above Grik, the upper reaches of the Jelai above Kuala Lipis, and the headwaters of the Tembeling may represent unsubmerged portions of old valleys, but unfortunately we do not know and cannot expect to know exactly how far submergence went. The plain of marine denudation may, I think, be recognized in Perlis and the low watershed between Perlis and Siam, in the lowlands of Kedah, dotted with little hills, in the watershed between the Plus and Kinta Rivers and the low country on either side of it between the Kledang and Kerbau Coulisses, and in much of South Perak, Selangor, and Pahang. In the last state I would emphasize one locality, the Pahang-Kelantan watershed immediately to the west of the Tahan Coulisse (8). This watershed is also the state boundary; but because it is so low and indefinite the boundary has not yet been accurately fixed. I have been to the place and have had good views of both sides of the watershed from Gunong Tahan and from a limestone hill close to the boundary. It has been selected as the route for a new railway now

under construction into Kelantan, and the Chief Resident Engineer for Construction of the Federated Malay States Railways informs me that the height of the railway on the boundary will be 628 feet. It is curious that this point, halfway across the broadest part of the Peninsula, should be so low and so close to Tahan, the highest mountain (7,186 feet); but if we admit the possibilities of marine denudation, it can be understood.

There are two factors that may have made the present drainage depart from the lines of the old continental drainage; one, the formation of new ridges by the irregularities of marine denudation; the other, the breaching of the island ranges by the same agency. On the west of the Main Range (6) a combination of both may account for the present courses of the Plus and Kinta Rivers. Let us suppose that in the continental stage, when the Archipelago was united to the mainland, there was no gap in the Kledang Coulisse through which the Plus could flow and that the Plus flowed south between 5 and 6, joining the Kinta. When the sea advanced up the Perak valley it may have broken through the Kledang Range on the site of the present Plus River and eroded the land on the other side towards the site of Sungei Siput. At the same time the sea would have advanced from the south between the Kledang and Kerbau Coulisses. Ultimately the two arms of the sea would meet making the southern part of the Kledang Coulisse an island. Then, when the sea retreated again, the Plus would flow through the breach made by the sea to join the Perak, and a low watershed would be left between the Plus and the Kinta.

Explanation of the Course of the Tembeling and Pahang Rivers

The course of the Tembeling and Pahang Rivers has been noted, and the following suggestions are now made to explain it. In the continental stage the Pahang River flowed between the Benom and Tahan Coulisses and continued its course in a south-southeasterly direction over the present drainage of the Muar. When the sea advanced it broke through the Tahan Coulisse east of the site of Temerloh, giving a new channel for the Pahang when it retreated again, reversing part of its southern drainage (now the Bera and Serting), and leaving a low watershed between the Serting and Muar. Similarly marine denudation, which could not break down the mass of Gunong Tahan, may have broken down the coulisse to the south of Tahan sufficiently to allow the Tembeling to flow through it; but this part of Pahang requires more detailed study. Another possible explanation that I have put forward for the present course of the Pahang, is that a stream flowing east from the Tahan Coulisse cut its way back and captured the Pahang, thus diverting it to the China Sea. Unfortunately, however, no stronger evidence than the general lie of the land now can be cited as evidence in support of either explanation. The dense jungle hides old river terraces, if such exist, and we can only say that either event would

account for the present course of the Pahang River and the low watershed (180 feet) to the south.

Marine Deposits and Raised Beaches

It may be objected that, if this submergence of the Peninsula took place, marine deposits laid down during that period should be visible now. In this respect there is very little positive evidence. Although on the neighboring island of Sumatra late Tertiary rocks are well developed, on the Peninsula as defined in this paper only three small patches are known: one in Selangor with coal, plant, and land-shell remains; another near Kuala Kangsar with limestone underlying a coal seam; and another on the Perlis-Siam border. There is good evidence of their being Tertiary but no means of determining whether they were deposited in the period of uplift in Miocene times that led to the Malay Archipelago being united to the continent of Asia or in the subsequent period of subsidence. The limestone near Kuala Kangsar points to marine conditions, of which there is no evidence in the other two patches; and it may have been formed when the sea converted the southern part of the Kledang Coulisse into an island.

In Kinta, certain high-level gravels may possibly have been laid down before the period of subsidence; but, whether this was so or not, any Tertiary deposits must have been subjected to considerable denudation after the sea retreated.

Apart from the biological evidence in the Peninsula, however, we must remember that movements which affected the area of the present Archipelago can hardly have failed to affect the area of the present Peninsula, so close are they one to the other; and for the last period of movement, which seems to be in progress still, that is the uplift which restored the Peninsula, we have more satisfactory testimony. At several localities near the coast raised shell beaches are found. I have seen them at the foot of Elephant Hill (between Alor Star and the sea, in Kedah), near the mouth of the Perak River, and near the mouth of the Bernam River. Mr. Leonard Wray says, "In a search for shell mounds in Lower Perak some interesting facts bearing on the formation of the coast and the valley of the Perak river were brought to light. At Pasir Panjang, Laut, there are no less than seven lines of old beaches, and between each there is a piece of low-lying land now used as padi fields."[8] From Kuala Selangor one can see a line of high land now far removed from the sea that has the appearance of an old coast line; while on Langkawi Island large stretches of sea sand in the interior of the island show that there must have been an actual uplift and that the sedimentation of the rivers is not the only factor concerned in the growth of the land.

In Perlis I found marine mollusca in a cave eleven miles inland and nearly 300 feet above sea level. This I have cited elsewhere as evidence of

[8] *Perak Museum Notes*, Vol. 2, Part I, p. 71.

uplift; but since doing so I have seen accumulations of shells in Langkawi that make me admit that, although these Perlis shells were buried in phosphate, they might have been taken to the cave by human beings.

The raised beaches are only about 50 feet above sea level. Unfortunately calcareous matter dissolves so quickly that one cannot expect shell beaches at great elevations, so that their absence farther inland and higher above sea level does not mean they never existed.[9]

On the east coast certain inland ridges, locally named "permatang," are believed to be old shore lines.

The similarity between the existing islands off the west coast and isolated hills rising from the coastal plain strongly suggests that the latter were quite recently islands in the sea, and in this regard we must not altogether despise native tradition. The idea that an inland hill was originally a ship navigated here by a Malay certainly does not inspire much confidence as evidence; but a legend that men from Acheen once attacked from boats a place now about seven miles inland on the Perlis-Kedah border, commands some respect.

There is no question that parts of the west coast are extending seawards today, e. g. the land at the mouth of the Kedah River; but, taking that case alone, deposition of sediment brought down by the river might account for the growth. The raised beaches, however, show that there has been an uplift as well.

Similarity of Islands and Hills

A journey by sea from Penang to the Langkawi Islands gives a strong impression of the close similarity of the islands and hills on the mainland. Penang is separated from Province Wellesley by a shallow strait. A slight elevation would make of Penang Island a hill much like Kedah Peak, clearly visible beyond the harbor. As one approaches the Langkawis, having passed several islets which have their counterparts rising from the Kedah paddy fields, the isolated limestone hills of northern Kedah and Perlis are seen rising from a flat, low plain, just as some of the Langkawi islets ahead of the ship rise from the sea.

[9] Mr. Boden Kloss informs me that he has seen old beaches at greater elevations than 50 feet.

AN EXPLORATION OF THE RIO DE ORO, COLOMBIA-VENEZUELA

By H. Case Willcox

[With separate map, Pl. VII, facing p. 382]

In the Republics of Colombia and Venezuela there exist large territories virtually unknown even within short distance of highways of communication. Regions trodden by the *conquistadores* in the earliest days of the discovery remain the haunts of savage tribes. This is the case in the Opón valley. Although this valley lies within sight of the Magdalena and was ascended by Quesada in 1536, a journey through it today is described as attended with no little risk. Farther north the Motilone Indians of the Sierra de Perijá close a long stretch of country on the Colombia-Venezuela boundary. Already before Quesada's expedition Alfinger had crossed the Sierra on his way from Lake Maracaibo to the César valley. We know little more of it today.[1] Some fifty years ago the Colombian government attempted a forcible "civilization" of the Motilones. The sole result was to provoke attack on the adjacent settlements (Valle de Upar) and to close the only trail across the Sierra de Perijá into Venezuela.

A special interest, however, attaches to this portion of the Colombian Andes. About Pamplona (latitude 7° 20′ N.) the Eastern Cordillera divides into a northeastern branch, the Venezuelan Andes, and a northern branch that dies out in the Montes de Oca. The northern branch constitutes the divide between drainage to Lake Maracaibo and the Magdalena, and in part (Sierra de Perijá) it forms the boundary between Colombia and Venezuela. The earliest boundary treaty between the two republics (1833) defined this section of their common boundary as:

> . . . the crests of the Montes de Oca and by these crests and those of the Perijá mountains until they meet the head-waters of the Oro River . . . the waters of this river downstream to its confluence with the Catatumbo.

The Sierra de Perijá has remained unknown, and no boundary disputes have arisen in connection with it. The above line was confirmed in the King of Spain's award (1891) but it has not yet been demarcated.[2]

A word must be said as to the usage of the term Sierra de Perijá. Locally the name is restricted to the eastern or Venezuelan side of the chain. On the Colombian side different sections go under different names. The more

[1] Wilhelm Sievers: Die Sierra Nevada de Santa Marta und die Sierra de Perijá, *Zeitschr. der Gesell. für Erdkunde*, Vol. 23, 1888, pp. 1–158; reference on p. 113.

[2] On November 3, 1916, a convention was signed between Colombia and Venezuela which provided that the President of Switzerland should act as arbiter for such portions of the boundary as are in dispute. A dispatch from Geneva dated May 10, 1921, announces that the Swiss Federal Council will arbitrate the dispute and that the necessary surveys will be made by Swiss engineers.

southerly portion is known as the Sierra de Motilone, and its southward continuation is termed the Cerro (or Cerros) de Bobali and the Sierra de Ocaña. This usage has been discussed in the article "An Exploration of the Sierra de Perijá, Venezuela" by the late Theodoor de Booy.[3] In 1918 Mr. de Booy conducted an expedition into the Sierra from the Venezuelan side about latitude 10° 30′ N. Farther south explorations have been carried on by various oil companies interested in the Barco Concession. This concession is described in the deeds as lying south of the Rio de Oro and between the Catatumbo River on the east and the Cerro Bobali and Sierra de Ocaña on the west. These explorations included a certain amount of work on the Rio de Oro not far from the petroleum wells and on the western flank of the Sierra Motilone and about the Cerro Bobali.

In 1920 the writer crossed the chain in reconnoitering on behalf of the Carib Syndicate for a route feasible for a railroad and pipe line from the navigable waters of the Magdalena to the petroleum wells which are situated on the Rio de Oro near its junction with the Catatumbo. A brief account of the expedition will now be given.

Explorations on the Western Side of the Sierra Motilone and Cerro Bobali

In June, 1920, I started from Cartagena in company with Mr. M. J. Bolan,[4] a railroad contractor and explorer, proceeding via Calamares by the Cartagena-Calamares railway (of which the major portion was constructed by Mr. Bolan in 1892) and up the Magdalena River to El Banco, a town of 4,000 population at the junction of the Magdalena and César Rivers. From El Banco we went up the Rio César, across Lake Zapatosa and landing at Soloa proceeded to Curumani in the foothills of the Sierra de Motilone where some investigations were made of the Rio Animito valley. We then returned to the Magdalena at Tamalameque, some miles above El Banco. Were communications available Tamalameque would serve as the outlet for Cúcuta and other interior towns of the department of Santander Norte which must now find their markets in Venezuelan territory. Various projects have been advanced for opening up such communications. Among them is the cattle trail constructed in 1885 but abandoned shortly afterwards. As we subsequently proved, even knowledge of its course had been lost. From Tamalameque we followed it for 67 miles, passing around the western shoulder of the central member of the three Cerro Bobali peaks at an elevation of 6,750 feet and climbing down four and a half miles on the other side and into the Barco Concession at an elevation of 5,000 feet. At this point it became clear that the route was not feasible for any type of

[3] *Geogr. Rev.*, Vol. 6, 1918, pp. 385–410.

[4] Mr. Bolan, who has had 30 years' experience in western South America, organized and equipped my expedition and was directly responsible for its success. His knowledge of the language, customs, and racial traits of the natives was invaluable in securing local co-operation.

FIG. 1

FIG. 2

FIG. 1—Bolan's Pass with Mt. Willcox in the background. (Photograph by courtesy of the Carib Syndicate.)
FIG. 2—The divide between the Magdalena and the Lake Maracaibo drainage seen from Mt. Guzman. (Photograph by courtesy of the Carib Syndicate.)

construction, and we turned our attention to the central and northern peaks of the Cerro Bobali. I measured their height by the boiling water method and found them to be 7,750 feet and 7,928 feet respectively. The northern peak, the highest elevation within a radius of 50 miles, is plainly visible to the traveler in fair weather while journeying on the Magdalena River at a distance of possibly 100 miles.

A few weeks later we made a partial exploration of the Colorado and Hondo Rivers, two of the eastern tributaries of the Magdalena system. The "Arroyo Hondo," as it is locally known, passes through the main sierra between the northern peak of the Cerro Bobali and the southern end of the Sierra Motilone. This is an instance of river capture, the stream now having its source in a basin on the eastern side of the mountain range. The eastern and northeastern edges of this basin are of a height ranging about 5,000 feet to 6,500 feet. Through a gap of the lower elevation—named "Bolan Pass"—we located a route for the construction of a transportation system which when completed will permit the petroleum of the Barco Concession to be transported to the Rio Magdalena.

Our next work was to construct a mule trail connecting the point known locally as Pesqueria on Lake Zapatosa with the pass. During the construction of this trail, which passes slightly southwest of the village of Curumani and on up the Rio Animito, I had occasion to make a full exploration of the Animito. At a point seven miles south of Curumani the river forks into eastern and western branches. The eastern branch finds its source in the Sierra Motilone; the western branch is formed by the union of three streams—two of which are named by local hunters the "Rio Horno" and the "Quebrada de Casa Piedra" (Ravine of the Stone House). The name of the latter is derived from the fact that at a sharp bend of this stream a huge cavern 100 feet long, 30 feet wide, and 8 feet high has been carved out of solid rock by the downrushing floods.

Expedition Down the Rio de Oro Planned

About this latitude (10° N.–7° N.) the Sierra has two well-marked rainy seasons. On the western side the rainy seasons are from mid-April to mid-May and from mid-September to mid-November; on the eastern side they are somewhat later. In the latter part of October every day there was a heavy downpour of rain continuing on an average 14 out of the 24 hours. This circumstance rendered any further construction impossible, and it was decided that I should proceed ahead with a picked party of men over the sierras and down into the valley which we had observed from the Cerro Bobali lying on the eastern side of Bolan Pass. This valley we hoped would be found to contain one of the sources of the Rio de Oro.

Up to this point, the summit of the mountain range, we had encountered no signs of the Motilone Indians; but the peons of my party could not easily overcome their dread of the savages, who are reputed to shoot, with

great precision, arrows four or five feet in length tipped with deadly poison. At first it appeared as if we should not be able to secure peons; but skillful argument and the promise of double pay eventually secured twelve men, ten Colombians and two Venezuelans. They were well armed and carried ten days' provisions, the maximum that could be carried under the circumstances. Dogs were also taken with us to assist in preventing a surprise attack by the Indians.

Crossing the Divide

On October 24, 1920, we left Campamento La Mesa de Bolívar, elevation 4,260 feet, where for a day or two we had been organizing our expedition, and proceeded up over the Sierra Motilone, crossing the summit at 6,400 feet where a temperature of 58° F. was recorded. We now passed into the cloud zone, and progress became very slow on account of the change in the vegetation to what is known by the natives as *loma*. This vegetation grows to an average height of 20 feet and consists of thickly tangled vines and moss, dripping with moisture. It is found enveloping all peaks in this vicinity from an elevation of 5,500 feet and upwards. It took us until October 28 to cut a passage over the summit and down to a small stream which fortunately proved to be one of the sources of the southern branch of the Rio de Oro. It was a mountain torrent with strong current and a cross-section area of approximately 20 square feet. We gained it at an elevation of 3,400 feet and there established our second camp, five miles northeast of Bolan Pass. Here the terrain was covered with dense forest quite plentifully stocked with such small game as gray monkeys and wild turkeys.

Upper Course of the Rio de Oro

Below an elevation of 1,500 feet we met with an insect quite common to these regions. It is known locally as the *jejan* and is a type of small fly, very persistent and annoying. Until we reached elevations under 1,000 feet the number of mosquitoes were surprisingly few, and at night there were practically none at all, as it becomes quite cool after sundown.

Rain fell throughout the nights of the journey and for a great part of the days, falling possibly on the average more than 12 out of every 24 hours. Numerous small creeks joined the branch of the Rio de Oro down which we were progressing, and at the point reached on October 30 it had become a fair-sized river. On this date at an elevation of 1,800 feet we passed a more considerable tributary coming in from the southwest. I believe it to be the stream referred to on some maps as the Rio Loro. On the following day we crossed a stretch of flat land covered with heavy jungle in which were found signs of tapir, deer, and wild pig. Our dogs frightened up a troop of the latter, and they charged our party while we were proceeding along in single file. It is a well-known fact that these animals once started in a certain direction will not deviate from their course but will attack with

their tusks every living thing in their path. The only thing to do when one finds oneself in line with such a charge is to step behind a tree and endeavor to attract as little attention as possible. On this occasion we shot one of the pigs, which are considered excellent meat by the peons. On the afternoon of this date while wading along down the river, which now was of considerable size, we had what proved to be our last view of the point in the sierras where we had crossed. It was 24 miles away from the spot where we were and 78 degrees west of south.

That night we camped a short distance up on the slope of a small sierra near the river. Rain fell continuously and heavily all night, and in the morning the river had risen so much that it was impossible to wade along the stream bed. We therefore took to the high ground and were greatly surprised to find an old trail, evidently constructed with considerable labor. It consisted of a path about three feet wide, excavated at some former time and laid along very gradual grades. It was the continuation of the cattle trail from Tamalameque to Cúcuta. The only existing maps show this trail after crossing over the Cerro Bobali as turning to the southwest and passing onward to Cúcuta; but we found, on the contrary that after dropping down to the Rio de Oro the trail follows the eastern and southern banks of the stream until it comes to the point where we encountered it, about 30 miles to the northeast of Cerro Bobali. We followed it where convenient for 30 miles more, but as it was quite overgrown with jungle much cutting was necessitated.

The Northern Branch of the Rio de Oro

At midday of November 3 and at a distance of 43 miles from the crest of the sierras we reached the northern branch of the Rio de Oro. This is a stream of somewhat larger size than the one along which we were traveling. Its source is, I believe, in a deep depression which I had noticed on the eastern side of the Sierra Motilone many miles to the north of our crossing point, I should say almost directly opposite Curumani. Near the junction of the two branches of the Oro the terrain consists of flat land, heavily jungled, while scattered over the surface are isolated boulders of hard rock.

Abandoned Fishing Camps

The following day we passed some abandoned Indian fishing camps a short distance above the junction of the Rio Tomas with the Rio de Oro. The Rio Tomas which enters from the south is, if anything, slightly larger than the Oro. Both rivers were here of great depth and strength of current. Here we found our first crocodiles, the presence of which made it impracticable to ford by swimming. After a short search we found some *balsa* trees, so known because of the very buoyant character of the wood which permits the tree to float readily even when still green.[5] With these we

[5] An interesting note on the occurrence of *balsa* wood is given by W. W. Rowlee: Synopsis of the Genus *Ochroma*, with Descriptions of New Species. *Journ. Washington Acad. of Sci.*, Vol. 9, 1919, pp. 157–168.

constructed a raft of sufficient size to carry in three trips our entire party across the river.

We continued for the next few days pressing forward along the eastern bank of the river, which although very crooked and erratic in its course, maintained a general direction to the north. At noon on November 6 we passed the mouth of a tributary stream possibly 70 feet in width, entering from the east. Hereabouts the valley was wide, and there appeared to be much open country. At this point we left the Tamalameque-Cúcuta cattle trail which turned to the east towards Cúcuta. Near here we shot two large female monkeys, which furnished much-needed food, as we had been without provisions for two days.

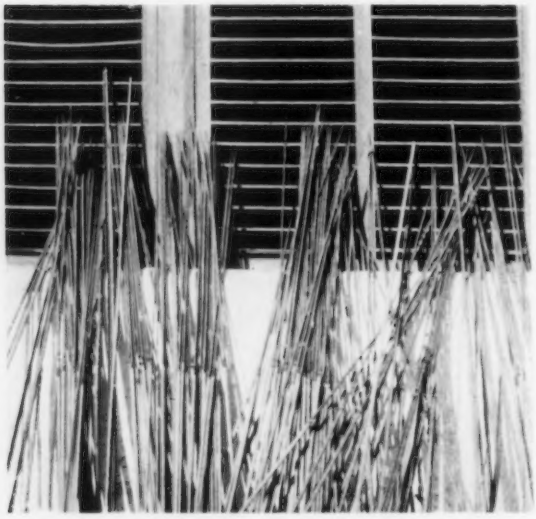


FIG. 3—Arrows and spears taken from Motilone Indians on the Rio de Oro. (Photograph by courtesy of the Carib Syndicate.)

SLOW AND ARDUOUS TRAVEL

From now onward our journey was a monotonous story of slow and arduous travel through heavy jungle and up and down the rock cliffs that bordered the river with little intermission. We passed through country broken by an endless succession of *quebradas* which, because of the frequent change in direction of the main stream, seemed to be running in all directions. We were compelled to follow the river closely, attempts to seek a shorter route being restrained by the fear of losing the river altogether once it should be out of sight or hearing. Nor were our attempts to descend by raft any more successful—we were immediately wrecked in the rapids.

One day (November 20), while a short distance away from and above the river and climbing a 2,000-foot hill, we encountered the first signs of any previous human presence that we had observed since we passed the abandoned fishing camp at the junction of the Rio Tomas. Following the ridge of this mountain we found a few machete cuts which had evidently been made by Indians. This trail we followed with much trouble, as it was very faint. Later we came down to the river again where we found an Indian raft secured on the opposite shore and constructed of two *balsa* logs tied together with *bejucos*, a vine that serves the native as a rope.

Our situation was becoming increasingly precarious. Our limited pro-

visions had been consumed. We shot one or two monkeys and a couple of wild turkeys. These with a few fish were the last game that we secured on the journey. The men were sick with fever and exhausted from lack of food. On the 29th day of the expedition we killed and ate one of the six famished dogs remaining with us, and two more on the next day.

Signs of the Motilones

At this time becoming desperate at the slowness of our travel I decided to strike back a short distance from the river into the highlands and attempt to cut off some distance round the bends. Shortly after taking this course we encountered an Indian trail which for a time proceeded in the direction desired, or practically due east. We went forward quite easily along it for possibly a mile and half but then began to fear that we were going to lose the river, without which I had no hope of ever arriving at a point in the Maracaibo basin. I decided to leave the trail and bear off to the left in an attempt to get in touch with it once more. In passing along the trail we saw four empty houses of the Motilones, two of which had evidently just been constructed, as the palms and *bejucos* which formed them had been freshly cut. Within, however, there was absolutely nothing—neither occupants nor food nor equipment. The huts were of the same type of construction as that in Figure 4.

An Important Indian Trail

While searching below we also came across a well-beaten trail, about four feet in width, following natural easy grades along through the hills and evidently much used. I believe that this is the main trail connecting the divisions of the Motilone tribes separated by the Rio de Oro. We turned and followed this trail to the river. On our way we found fresh skins of plantains, evidently dropped by the Indians, and, on again reaching the river, an Indian *balsa* raft tied up to the bank. A little later we heard a slight noise below and found that a party of five Motilone Indians had come down from the same direction that we had followed and were preparing to embark on the raft. All were well armed with bows and arrows and one with a steel machete. Three of the Indians carried packs on their backs, evidently containing plantains. Apparently they had not noticed the passage of our party down the trail. The peons who had followed me were barefooted and had undoubtedly obliterated my boot prints. The Indians used two long poles to propel their crude raft across the river and, after securing it on the opposite shore, passed into the forest and disappeared.

Building a Raft

At the close of that day (November 22) about a hundred yards from the point where our camp site was pitched we discovered, much to our surprise, nine *balsa* trees with an average diameter of about twelve inches. The

existence of these trees at this point was surprising. For the past fifteen miles we had looked carefully for trees of this type and could find none and had decided that we had passed the limits within which they grow. Early next morning I assembled such of the men as were fit to work for the construction of a raft. Of the twelve there were only four who could stand on their feet and effectively use our one axe and machetes. The remaining eight lay around the fire and groaned or talked about the "end" which they believed was very near. These natives possess very little spirit and in danger or during privation are anything but cheerful companions. The

FIG. 4—Motilone hut near the Rio de Oro. (Photograph by courtesy of the Carib Syndicate.)

nine trees we felled were dragged to the river and fitted together with three cross pieces secured very firmly at the joints with *bejucos*. About midday we had built a very strong raft.

LAST STAGES OF THE JOURNEY

It was necessary for us to get away from that spot with speed, as the guards I had posted on the cliffs above the river reported fresh signs of Motilone Indians; and I believe had we remained we should have been unpleasantly reminded of their presence before the day was over. We placed all of our equipment and the one remaining dog aboard the raft and started about one o'clock. About a half mile below the point where we embarked we encountered strong rapids. Several times the raft went aground on boulders, but by jumping into the water we managed to get it clear of these obstructions. After passing this point we did not find any other dangerous rapids, though there were many places where the river became narrow and swept around sharp bends. We proceeded along at a rate of six miles an hour with but little trouble.

Two miles below where we launched the raft we entered an entirely different region. The country on either side was that commonly known as the *llanos*, here densely forested. Hills had almost entirely disappeared. A few wild turkeys and other small game were observed in the forests on either side. About two o'clock, and at a distance of 125 miles from the point where we first reached the source of the Rio de Oro, we passed the junction of the Rio Motilone. The Rio Motilone at the point where it joins the Rio de Oro is about 300 feet in width at this period of high water and is but slightly smaller than the Rio de Oro.[6]

FIG. 5—Jungle on the banks of the Rio de Oro near its junction with the Rio Catatumbo. (Photograph by courtesy of the Carib Syndicate.)

We continued onward for another hour and then landed and prepared a camp for the night on a small beach. Hoping that it would not rain, and much against my better judgment, I selected this as a site contrary to our usual custom. To have encamped on higher ground in this vicinity would have necessitated much clearing with machetes because of the heavy jungle all along the shore. Near this camp site we found a smaller type of plantain known as *guineos*. These were green and about four inches in length but when boiled proved to be very palatable. We gathered many and ate them at intervals throughout the night, as it was the first food we had had for many days. At midnight the rain, which had ceased for about eighteen hours, began once more, and the river gradually rose and finally covered the *playa*, or beach. Rainfall continued until daybreak, and the first light found us standing in water to our waists and endeavoring to keep hold of the raft upon which depended our salvation. Shortly after daybreak the downpour ceased, and the river began to subside until at 9:30 it had receded

[6] An exploration of the Rio Motilone to its source has been made by Mr. A. Faison Dixon, in a geological reconnaissance from the Colon oil area.

so much that I deemed it safe to embark, although the current was still bringing many fallen trees and wreckage from upstream.

Now, as well as during the latter part of the previous day, the river swung from an easterly direction to south and southwest and even at times westerly, describing a series of great loops. At one time we probably were only a few miles distant from the point where six days before we had been toiling laboriously on foot.

Arrival at the Oil Wells

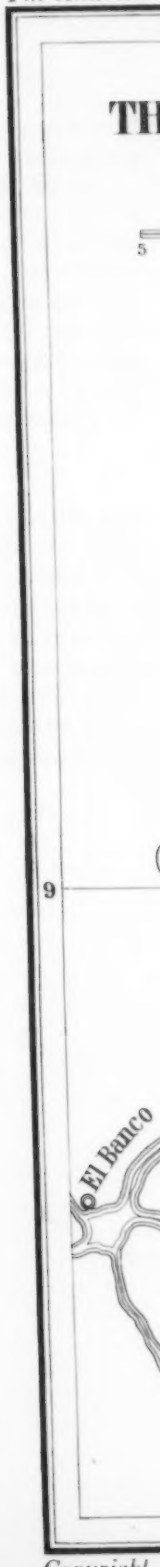
On November 24, the 32nd day of the expedition, and at a distance of 156 miles from where we had found the source of the Rio de Oro, suddenly rounding a bend in the river we came in sight of an island covered with cultivated plantains. We next saw a cluster of buildings which one of the peons who had formerly been employed at the wells recognized as the camp of the Colombian Petroleum Company, our objective. As we came into view of the camp the peons, who had asked my permission in the early days of the expedition, began firing their rifles and revolvers in the joy of once more seeing signs of civilization and the hope of soon securing food. When the noise of this fusillade reached the camp the employees of the petroleum company at once rushed for their rifles, believing that they were attacked—not by the Motilone Indians, who have no firearms, but by a force of revolutionists—and it was only when they saw our men discharging their firearms in the air that they knew that we were friends.

We spent two days at the petroleum camp, during which time we fitted ourselves out with much-needed clothing from the company's commissary and ate a meal nearly every two hours of the forty-eight. The effect of our hunger was so nerve-racking that it was impossible to sleep except for a few minutes at a time.

Departure for Maracaibo

At 2 o'clock on the morning of November 27 the management turned over to my use a canoe and two giant Venezuelans for canoemen. We left quietly to attract as little notice as possible, inasmuch as many parties had been attacked by Indians on the Rio de Oro in the twelve-mile stretch between the petroleum camp and the junction with the Catatumbo.

The country we passed through was *llanos*—great stretches of fairly level land hereabouts covered by gigantic forests of *ceiba*, a soft-wood tree, and *caracoli* and many other hard-wood trees. On the beaches were large numbers of crocodiles, for this was the season in which they lay their eggs along the shores. For this reason it was also a dangerous time to travel on the river, as the Indians hunt these eggs for food. The forests abounded with game. I saw three different kinds of monkeys, deer, tapir, and several species of wild turkey. It was not until we had traveled 90 miles that we saw the first signs of human existence after leaving the petroleum wells.



74

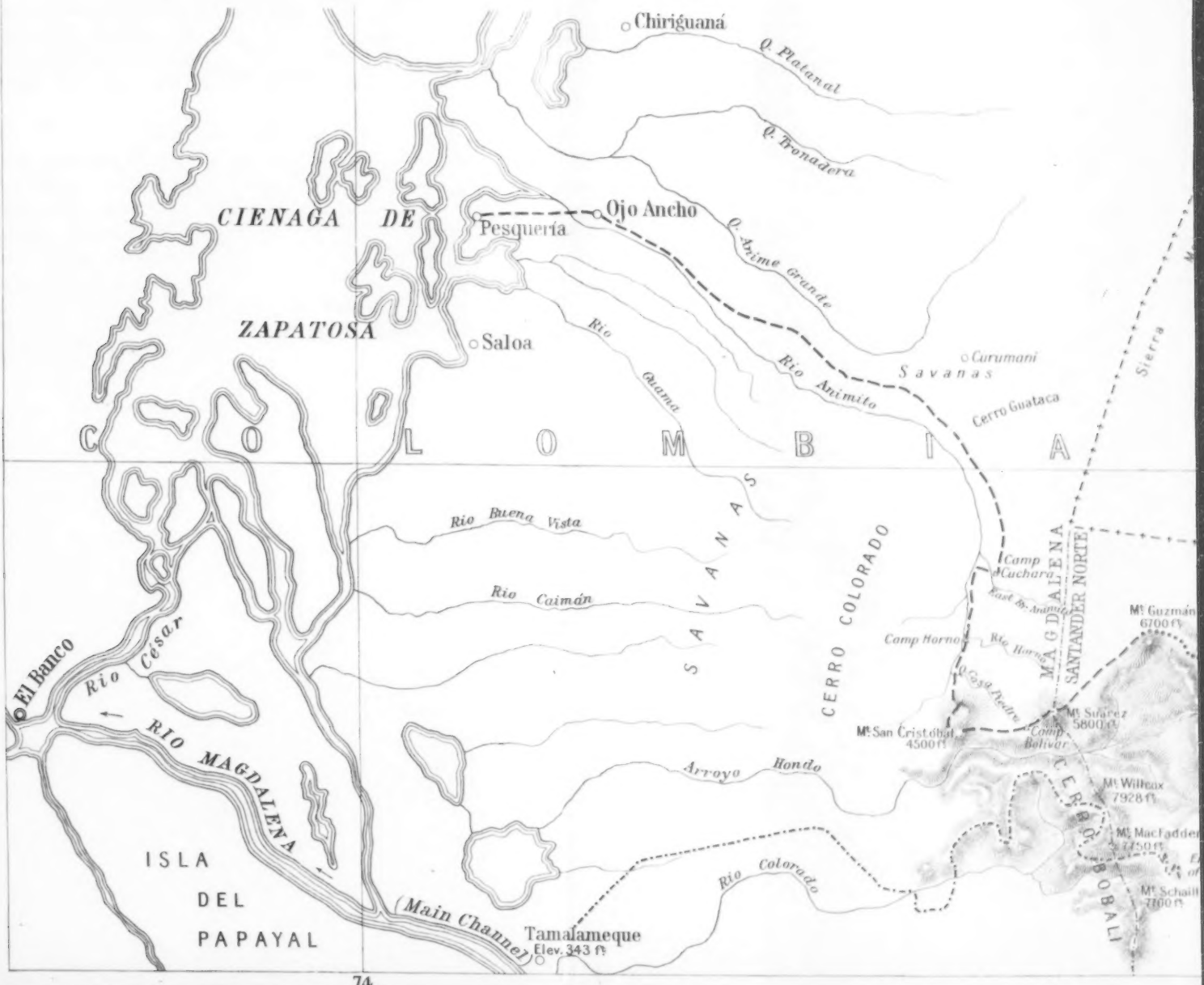
MAP OF
THE CERRO BOBALI AND THE RIO DE ORO

From route surveys by H. Case Willcox, 1920

Scale 1 : 325,000

5 0 5 10 15 20 miles

5 0 5 10 15 20 25 kilometers



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74

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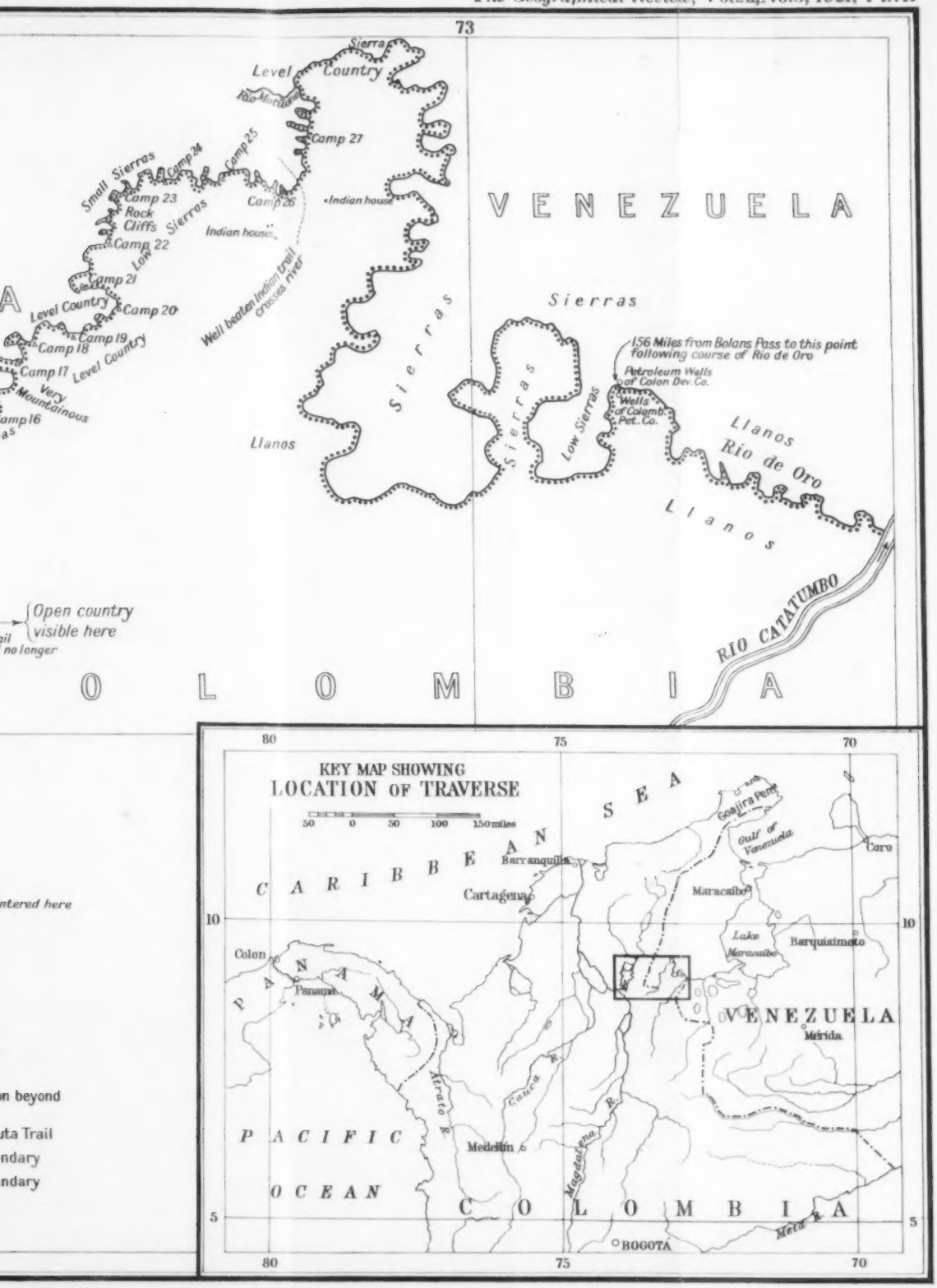
VENEZUELA
Sierra Motilones
Curumani
Savanas
Cerro Guataca
Camp Cuchara
East Br. Aruanca
Camp Horno
Río Hornito
Casa Piedra
Mt. San Cristobal 4500ft
Camp Bolivar
Mt. Suarez 5800ft
Mt. Guzmán 6700ft
Camp
Camp 2 3400ft
Camp 3
Camp 4
Camp 5
Bolans Pass 5000ft
Mt. Willcox 7928ft
Mt. MacFadden 7750ft
Mt. Schaill 7300ft
End of Explorations in July of Tamalameque - Cúcuta Trail
MAGDALENA
SANTANDER NORTE
CERRO BOBAL
COLORADO
Perpendicular Cliffs
Flat Country
Cone shaped hills
Flat Country
Camp 6
Camp 7
Tamalameque - Cúcuta Cattle Trail first encountered here
Sierras
Río de Oro
Sierras
Flat Country
North Br. R. de Oro
2 Fishing Camps of Indians
Camp 8 R. Tamas
Camp 9
Camp 10
Camp 11
Large unnamed tributary enters Río de Oro
Tamalameque - Cúcuta Trail turned eastward and could no longer be utilized
Open cou
visible he
Camp 12
Sierras
Crossed River and followed North bank between these points
Sierras
Camp 13
Camp 14
Camp 15
Camp 16
Sierras
Very Mountainous
Camp 17
Very Mountainous
Camp 18
Level Country
LEGEND
Constructed Trail
Route of Expedition beyond Constructed Trail
Tamalameque - Cúcuta Trail
International Boundary
Departmental Boundary



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ndary

At 9:30 P. M. the outlines of Encontrados showed ahead of us, and shortly afterwards we pulled up to the docks among some sail and gasoline boats. With the aid of the current my two peons had paddled me a distance of 105 miles in 19½ hours. Encontrados is a town of 2,000 population. In the day time it has a sizzling, humid temperature, which at times reaches 110°. It lies at the southern terminal of the steamer route which connects northerly with Maracaibo. It is also the northern terminal of a short railroad, the Gran Ferrocarril del Táchira, which connects Encontrados with a point in the south called Estación Táchira, a few miles across the international boundary from Cúcuta, Colombia. From Encontrados I secured passage on the biweekly river boat which plies between the town and Maracaibo.

Result of the Journey

I believe that this journey is the only passage made across the great block of territory lying between the Rio Magdalena on the west and Lake Maracaibo on the east and between the latitudes of 10° 30′ N., the approximate location of the disused trail across the Sierra Perijá, and 8° 30′ N., the location of the abandoned cattle trail from Tamalameque-Cúcuta. It is the only exploration made of the Rio de Oro between one of its sources and its junction with the Catatumbo. Its result has been to place on the map 168 miles of river where heretofore some dozen leagues of fanciful watercourse were shown.

THE RATON MESAS OF NEW MEXICO AND COLORADO*

By WILLIS T. LEE
U. S. Geological Survey

The Raton mesas, or table-lands, are situated east of the Rocky Mountains in southern Colorado and northern New Mexico. They occupy a belt 25 miles or more in width extending from the town of Raton, N. Mex., which is situated about forty-five miles east of the foothills proper, eastward into Oklahoma a distance of nearly 100 miles. They differ greatly in size. Some rise only a few feet above the general level of the plain on which they rest, others more than 3,000 feet above this plain.[1]

There is difference of opinion as to the name appropriate for this group of mesas. A few writers have used the name "Mesa de Maya" as a collective term after the largest of the group. Others use the term "Raton Mesas," adopted from the loftiest and best known of the group. The latter conforms to local usage, and "Raton Mesas" is the term used generally in the thickly populated region near the western end of the group, whereas few people have ever seen Mesa de Maya. The term "Raton Mesas" is also used by the U. S. Geological Survey, which now employs the term "Raton Mesa region."

The word "mesa," meaning table, is used in the southwestern part of the United States almost exclusively in place of table-land, and most of the mesas would be called table-lands or plateaus in other parts of America. However, the term is applied rather loosely; and in many instances terraces, benches, and other types of land form are called mesas.

The Raton mesas are all true table-lands, having flat tops and precipitous slopes on all sides. The surface from which they rise is a part of the Great Plains, which at the western end of the mesa region is about a mile above sea level. This surface falls gently away from the mesas to the south, east, and north; and the streams rising in these highlands radiate from them in these three directions, winding over the mile-high plain for considerable distances before dropping into the narrow canyons, some of which are more than 1,000 feet deep.

There are three major surface levels, which give the mesa region the form of a broad complex pyramid: a lowland plain south of the 1,000-foot Canadian escarpment, which extends from a point south of Las Vegas northeastward past Clayton, N. Mex.; an upland plain between this scarp

* Published by permission of the Director of the United States Geological Survey.

[1] This article deals with the physiography of an interesting region the human aspects of which were touched on in the article by Charles R. Keyes: The Hanging Gardens of the Mesa de Maya, *Geogr. Rev.*, Vol. 8, 1919, pp. 145–152.

corresponding to the Canadian escarpment and the mesas; and the high table-lands, or Raton mesas, which culminate in Fisher's Peak. Toward the east and north there is no intermediate scarp corresponding to the Canadian escarpment, and the plain slopes gradually from the foot of the mesa scarp to the level of the Arkansas River, whose valley in relations corresponds in a general way to the broad Canadian valley south of the great scarp.

The mesas are remnants of erosion, parts that were not worn down to the general level of the Great Plains. Their shape results from the character of the rock composing them. Each mesa has a table top, or cap rock, of hard basalt which was poured out from numerous volcanic vents as molten lava at a time when the general surface of southern Colorado and northern New Mexico was relatively much higher than now. Under the lava cap are comparatively soft shale (Cretaceous) and coal-bearing shale and sandstone (chiefly Tertiary). Because these easily eroded rocks are protected by sheets of hard cap rock, the mesas maintain steep sides as they are slowly eroded away.

The larger mesas rise to altitudes ranging from 7,500 to 9,500 feet above sea level, or 1,000 to 3,000 feet above the surface of the plains. In consequence of the altitude rain falls on the mesas while the lower plain around remains parched and dry. It is no uncommon circumstance for a mesa top to be shrouded in cloud for considerable periods and kept moist as if drenched with heavy dew. During my survey work on Johnson Mesa a rainy night was followed by foggy weather and a slow drizzle of rain. No outdoor work could be done, and towards noon we started for Raton. On reaching a point a few hundred feet below the rim of the mesa we passed below the fog or cloud and about two miles from the rim encountered bright sunshine. But the top of the mesa remained shrouded in cloud most of the day.

But while the mesas are high enough for frequent summer showers they are also high enough for disastrous frosts in late spring and early fall and for heavy winter snows.

Some one has said that mesas are inverted oases. If an oasis is a "hole in the ground," as Mark Jefferson has said, a mesa may be termed a "hole in the sky." The Raton mesas are productive areas in the desert realm of cloud, for they are not so high as to be barren on account of the cold. Some of them are used for grazing, others for tillage. As grazing areas they have both advantages and disadvantages. There are practically no trees on the mesa tops, although the sides are well forested except where the slopes have been stripped for lumber or firewood. Grass grows luxuriantly, but if the cattle are not brought down before snow falls many of them die from exposure and from accident on the steep slippery trails. Another drawback to the mesas as pasture lands lies in the electric storms, for many an animal is killed there by lightning. During our work on the mesas, where we traveled chiefly on horseback, we soon learned to dismount and seek low ground at the first flash of lightning.

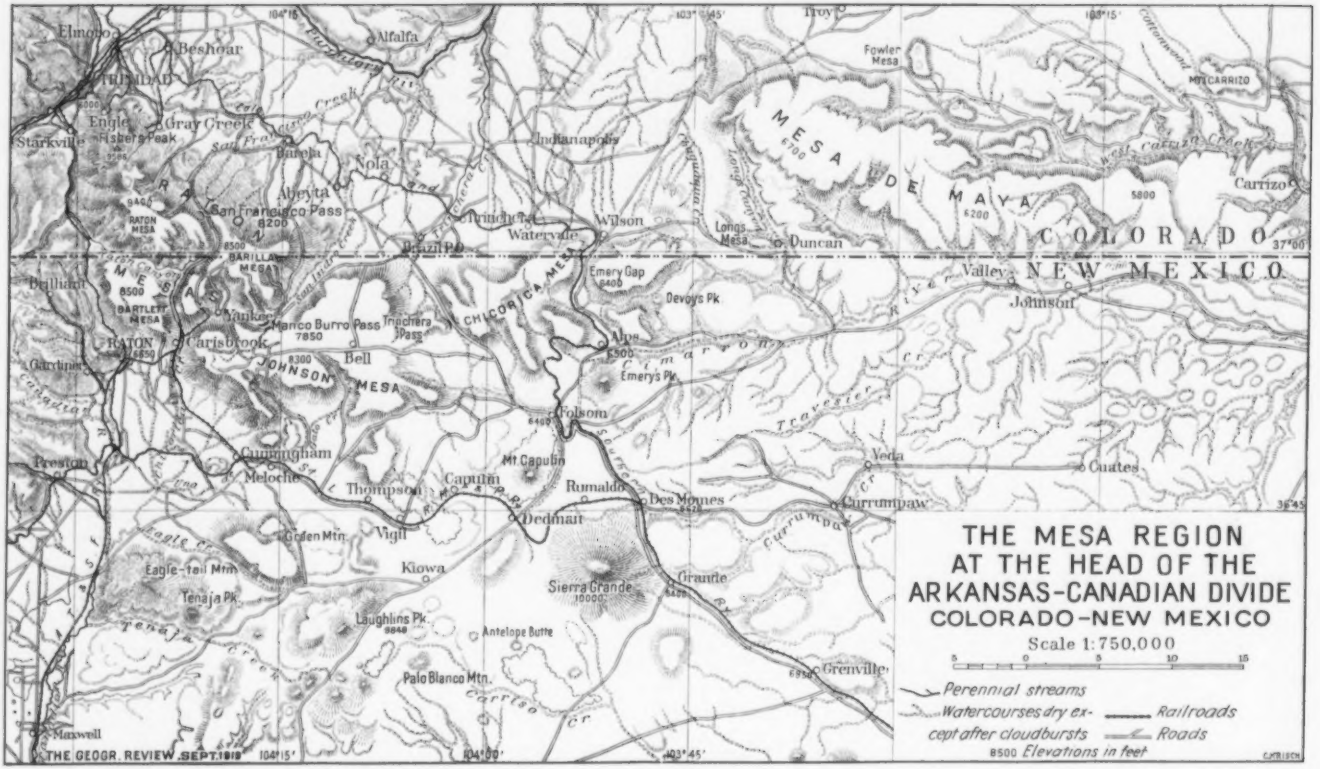

FIG. 1—Map of the Raton Mesa region. The term Raton Mesas is used both in a restricted sense, as on the map, and in a collective sense for the entire region. The latter is the usage of the U. S. Geological Survey (see U. S. Geol. Survey Prof. Paper 101, 1917). The sources upon which the map is based are of unequal value: only a third of the area is covered by topographic sheets of the U. S. Geological Survey. For detailed note on sources see footnote on p. 145, *Geographical Review*, Vol. 8, 1919.

Johnson Mesa is the one most extensively used for agriculture, and thousands of acres of its surface are under cultivation. The rich black soil derived from the disintegration of basalt produces good crops of hay and grain and such other products as can withstand the rigors of the climate. But the communities, although within sight of the through lines of traffic, are really far from them, and the traveling public knows little of these dwellers among the clouds. From their lofty stations the mesa men gaze unobserved over broad fields of activity. The Colorado and Southern Railway, which connects Denver with the Gulf of Mexico, skirts the mesas on the north and east; and the Santa Fe Railway, one of the chief transcontinental thoroughfares, on the west and south.

The mesas owe their existence to volcanic activity. Ages ago molten basalt flooded the surface and hardened into resistant layers. Where the soft older rock was not covered with lava it was worn down by rain and stream, and a lower plain was formed. The lava outpoured on this lower plain, and again the surrounding country was eroded away. This process continued and resulted in a number of lava-covered benches such as those shown in Figure 5, page 390. There are three well-marked and conspicuous benches and several less extensive ones. Each has its distinguishing characteristics, chiefly volcanic. Hence a study of the mesas is largely a study of a great but little-known volcanic district.

Features of the Mesa Region Observed from the Santa Fe Railway

Travelers over the Santa Fe route pass through Trinidad, Colo. Those interested in natural objects will notice a conspicuous height of land which rises about 3,600 feet above this station. It is called Fisher's Peak, although in reality it is not a peak, properly speaking, but only the projecting point of Raton mesa, the peaklike appearance being due to perspective. The main part of the high table-land of Raton Mesa is beyond the point and cannot be seen. The blocklike appearance of the top of Fisher's Peak is due to the lava cap, about 600 feet thick, which consists of several sheets of basalt. This cap of hard rock rests on soft, easily eroded sandstone and shale containing the beds of coal that make the Raton Mesa region one of the most important coal-mining centers in western America.

On leaving Trinidad the westbound train with two extra engines as helpers toils laboriously up the steep, winding grade to Raton Pass—a climb so difficult that in order to divert heavy traffic from it a new Santa Fe line was constructed across half of New Mexico and parts of Oklahoma and Texas.

For many miles Fisher's Peak is the most conspicuous object of the landscape. At its base lies Starkville, the first coal-mining town passed on the route. The coal is taken from under Fisher's Peak, and the mine workings extend through the northern part of the mesa and emerge on the

opposite side. Three other coal-mining towns are passed on the way to the crest, where the traveler crosses the state line into New Mexico and plunges almost immediately into a tunnel which penetrates the highest ridge of the pass. The last mine before the tunnel is reached is named for Dick Wootton, an early scout, Indian fighter, and associate of Kit Carson. At a time long before the railroad was built, when this part of the country was full of hostile Indians and still more hostile "bad men,"

FIG. 2—Fisher's Peak as seen from a point near Trinidad, Colo. The "peak" rising 3,600 feet above the town is the point of Raton Mesa whose flat top is maintained by sheets of hard basaltic lava.

Wootton constructed a toll road over Raton Pass and at his headquarters collected toll from those whom he could persuade to pay. Be it said, however, that he reached opulence and a ripe old age, in part by virtue of not seeing and hearing things which did not immediately concern him, and in part by his well-known ability to defend his interests against all comers. From the tunnel southward the road skirts Bartlett Mesa and at the town of Raton is again on the plain which was left at Trinidad.

From points south of Raton a variety of interesting natural features may be observed. To the east Johnson Mesa rises boldly from the plain. Farther south is a large group of volcanic mountains. Mt. Laughlin may be recognized by its smooth oval form, Mt. Tenaja by its square flat head, and Eagletail by its dark-colored pointed summit. Eagletail is an old volcano. A broad cone with gently sloping sides was built long ago by molten igneous rock. Then followed a long period during which the mountain was eroded.

In relatively recent time volcanism was renewed, and a steep-sided cinder cone was formed at one side of the old crater. This cone is covered with piñon pines, which make it dark-colored and give it the appearance of being distinct from the older parts of the mountain which are devoid of trees. To the right of our route are the precipitous bluffs of coal-bearing rocks. In the sheltered nooks at the foot of the bluffs formed by streams which have cut numerous canyons in the highlands nestle the mining towns of the Raton coal field. Here is produced much of the coke used in the smelters of the Southwest.

Bartlett and Johnson Mesas

Turning attention again to the mesas proper, the one nearest to Raton is Bartlett Mesa, whose nearly flat top, six miles long and four miles wide, is about 2,000 feet above the town. The cap rock consists of columnar basalt and terminates in steep cliffs which can be scaled in few places. Near the northern rim is a volcanic cone which marks the vent through which the basaltic lava of the cap rock was extruded.

Directly east of Raton at a distance of six miles is the western end of Johnson Mesa. The main part of the mesa lies farther to the east and has not yet been mapped with the same degree of accuracy as the western end. Like Bartlett Mesa it is lava-covered and rises to a general altitude of about 8,500 feet above the sea. From this general level, however, peaks of igneous rock rise to still greater heights. Towndrow Peak, a beautifully conical mountain of pink andesite, rises about 300 feet above the general level of the mesa. A few miles east of this peak is a recently formed cinder cone, and still farther east are several other peaks of volcanic rock.

The basalt of Johnson Mesa is columnar in many places, and the rim is generally so precipitous that the expense of constructing roads and even trails is heavy. The sheets of lava are horizontal, like those shown in Figure 5, but in some places along the precipitous rim the ends of congealed lava streams are exposed where they have been truncated by erosion, showing columns radiating from the center which indicate progressive cooling from circumference towards center. Looking northward from the rim the observer obtains a beautiful view of the steplike structure of the mesas caused by alternate erosion and extrusion of lavas. Figure 6 shows two of these mesa levels.

Features of the Mesa Region Observed from the Colorado and Southern Railway

Some of the most interesting views of the mesas are to be obtained from the Colorado and Southern Railway between Trinidad, Colo., and Des Moines, N. Mex. This road skirts the high mesas for a distance of 80 miles. On leaving Trinidad the southbound traveler goes in a general south-

FIG. 3

FIG. 4

FIG. 5

FIG. 3—Johnson Mesa as seen from Raton, N. Mex.—a lava-covered table-land rising 2,500 feet above the plain on which it rests.

FIG. 4—Towndrow Peak, a conical mass of pink andesite rising 300 feet above the top of Johnson Mesa.

FIG. 5—The rim of Barilla Mesa as seen from Johnson Mesa. The cap rock is made up of several sheets of basalt.

FIG. 6

FIG. 7

FIG. 8

FIG. 6—Parts of Bartlett Mesa in foreground and the higher older Raton Mesa in the background. Raton Mesa was partly eroded away before extrusion of the lava which now caps the younger and lower mesa.

FIG. 7—Mt. Capulin, N. Mex., a crater cone of recent origin consisting of cinders and flow lava. It is about 8,200 feet in altitude and rises 1,300 feet above the plain on which it rests.

FIG. 8—View of Baby Capulin, a very young cinder cone near Folsom, N. Mex.

easterly direction along the base of Raton Mesa, then of Barilla Mesa, and finally turns southward around the eastern end of Chicorica Mesa through Emery's Pass, which has been famed for rough going ever since the early pioneers found difficulty in urging their ox teams over this rough stretch of the old Santa Fe trail.

At this pass the traveler leaves the great Mesa de Maya on his left and winds about the eastern end of Chicorica Mesa, avoiding the rugged slopes on his right and the deep tributary gorges of the Canyon of the Dry Cimarron on his left; doubles back to the west around the head of this canyon; and finally emerges from the hills into one of the most remarkable volcanic districts in America, filled with crater cones and lava flows and a variety of minor land forms characteristic of a volcanic region.

Mt. Capulin, a Recent Crater-Cone

Mt. Capulin is the most conspicuous object in this district. It is a truncated cone of recent origin, composed partly of flow lava and partly of volcanic cinders. This cone rises 1,300 feet above a platform of flow lava whose surface lies at an altitude about 6,700 feet above sea level. In the summit is a cup-shaped depression, or crater, about a quarter of a mile across, inclined toward the west so that the eastern part of the rim is 300 feet or more higher than the western part. The crater marks the vent through which the lava of the cone reached the surface. In this respect Capulin differs from some of the conical mountains of igneous rock in this district, which show no evidence that they ever had a crater. To distinguish it and other cones of like character from conical mountains formed in other ways, the term "crater-cone" is here used to designate a cone built up around a volcanic vent by lava which reached the surface through that vent either in a molten state or in fragmental condition. As Capulin has a well-defined crater and was built partly of molten lava and partly of cinders extruded from that crater, it may be regarded as the type of a crater-cone. This splendid product of volcanism has been reserved by the United States Government as a national monument.

Many voluminous floods of lava were extruded from this great vent. One made its way down the Canyon of the Dry Cimarron for a distance of about 27 miles. Others spread out in broad sheets covering large parts of the plain. Some of these flows are so recent that little soil has accumulated on them. Caves formed by the flow of molten lava from beneath the hardening crust are numerous, and there are many domelike "blister cones" where the cooling crust buckled before the flowing mass became stationary.

From the top of Capulin a remarkable panorama opens to view. Lava flows and crater-cones, some composed of cinders and others of flow lava, appear as far as the eye can reach. Toward Folsom one gazes downward directly into the throat of two small cinder cones called Little Capulin and Baby Capulin. The latter consists of a circular rim of cinders about 200

FIG. 9

FIG. 10

FIG. 9—A "blister cone" at the foot of Mt. Capulin formed by the buckling of the crust of partly cooled lava.

FIG. 10—View of lava field northeast of Mt. Capulin and of a very young volcanic vent as seen from the top of the great cone.

FIG. 11—Sierra Grande, an old, deeply eroded volcanic cone near Des Moines, N. Mex. The photograph well illustrates the approach of the characteristic violent storm commonly known as "cloud-burst."

FIG. 12

FIG. 13

FIG. 12—Mt. Robinson, a crater cone near Mt. Capulin, intermediate in age between the younger cones of the Capulin group and the old cones represented by Sierra Grande.

FIG. 13—Three generations of flow lava shown in the Canyon of the Dry Cimarron east of Folsom, N. Mex. An ancient lava flow from Mt. Emery, which is situated on the highest bench shown, entered the canyon and was partly eroded away before a recent flow covered the floor of the canyon.

feet high with a cup-shaped crater reaching down nearly to the level of the surrounding plain.

Close to the foot of Mount Capulin is a young vent which may be called an embryo volcano. To one looking directly downward from the top of Capulin this vent has the appearance of a horseshoe. On the ground it appears as a genuine crater nearly circular in outline and 200 feet in diameter. The rim consists of flow lava about 10 feet high and 20 feet wide, broken away for a space of 50 feet where the molten lava left the crater. It is doubtful if more than one flow of lava was extruded from this vent. It might be called a one-eruption crater.

It is not known when these craters were formed, but their fresh appearance indicates recent origin. It can safely be said that some score or more of the cones were formed when the general surface of the district was more than a mile above sea level. The one on Bartlett Mesa and that described from Johnson Mesa (Fig. 6) rest on surfaces about 8,500 feet above the sea. These lava flows and crater-cones should be a sufficient refutation of the statement, still frequently repeated, that volcanoes form only near the seashore.

Sierra Grande, an Old Crater-Cone

Des Moines, N. Mex., where the Raton branch of the Santa Fe Railway joins the Colorado and Southern, lies at the base of Sierra Grande, a very old crater-cone and one which differs notably in shape from the younger cones of this district. Apparently it was formed by the extrusion of fluid, freely flowing lava, which built up a cone of broad base and gently sloping sides. This cone is so old that the crater has been almost wholly destroyed. Its position is marked by a hollow in the side of the peak and by the presence at the summit of red scoriaceous lava filling the old conduit which was once the throat of the volcano.

The altitude of Sierra Grande is known only approximately. According to aneroid reading it is nearly 8,500 feet, or about 2,500 feet higher than the plain on which it rests.

The clouds shown in the illustration of Sierra Grande may be worth passing mention. The mesa country is visited frequently by the short violent showers of rain and hail commonly known as "cloud-bursts." These cloud-bursts are often locally disastrous. It is not uncommon for every green thing to be destroyed by hail within a narrow belt sometimes less than a mile wide, while no damage is done on either side.

Crater-Cones of Intermediate Age

Near the very recent crater-cones of the Mt. Capulin group are several older craters. At an escarpment just north of Capulin the surface rises abruptly from the plain on which the young cones rest to a bench in the side of the mesa several hundred feet above the lower plain. This bench is a remnant of a surface which was largely eroded away to form the lower plain

and later covered with lava. It consists of sheets of basalt overlying shale, and on it are volcanic cones now partly worn away. These belong to a group of some dozen or more relatively old crater-cones, which may be called middle-aged volcanoes, as they are intermediate in age between the younger cones represented by Capulin and the still older ones represented by Sierra Grande described above. Mt. Robinson situated west of Folsom may be selected as the type of this middle group. It consists of highly scoriaceous lava, much of it so light in weight that it would float readily on water. Any cinders which may have once accumulated about it have disappeared. The slopes are worn to smooth soil-covered surfaces. The crater as originally formed has been modified in shape until it now resembles an inclined U.

The volcanic cones about Mt. Capulin correspond in age in a general way to the stages of mesa development. The old, deeply eroded Sierra Grande is a result of the ancient volcanism which produced the lava caps of the higher mesas. Those of middle age, represented by Mt. Robinson, correspond to the mesas of intermediate height; and the lavas from Mt. Capulin, resting on the recently eroded plain and on the floor of the youngest canyons of the region, correspond in age to the last cycle of erosion.

At one point in the Canyon of the Dry Cimarron I was fortunate enough to get a photograph (Fig. 13) showing three generations of lava flows. An ancient volcanic cone called Emery's Peak stands northeast of Folsom near the rim of this canyon. Ages ago basaltic lavas extruded from it, flowed over the rim, and accumulated on the floor of the canyon. Later erosion deepened the canyon many hundreds of feet, but the old bed of lava was not entirely removed. Some of it still remains as a broad shelf in the side of the canyon. At a still later time a stream of molten lava from Capulin or from one of the neighboring craters flowed down the canyon. Remnants of this lava flow remain as the dark-colored craggy masses on the present canyon floor.

PHYSIOGRAPHIC EFFECTS OF THE VOLCANISM OF MT. ST. HELENS *

By Willard Rouse Jillson
Kentucky Geological Survey

Mt. St. Helens, lying roughly midway between Mts. Rainier and Hood, is more remote and less well-known than either of these peaks. The plateau from which it rises is minutely dissected and densely forested. Only two wagon roads, bad beyond description, approach the mountain fastness; none traverse it. The lower river bottom farms, rich though circumscribed, become gradually smaller and poorer as one approaches the headwaters. Lately fenced grass-carpeted meadows, studded with neat white-painted barns and houses, give way to bushy stump-lot clearings and single-room log cabins. These in turn becoming more infrequent stand with their backs to the virgin timberland of hill and mountain side. All through the countless inner hills and valleys, beside abandoned overgrown trails and again in the most remote and inaccessible places, are found deserted cabins, now moldering into ruins, the homes of former prospectors. Though indications of mineral wealth—gold, silver, and copper—sufficient to fascinate the novice may be found at every hand, the miserable failure of the region generally to respond to diligent search and commercial exploitation is only too apparent. The great forests of Douglas fir and kindred evergreens, now largely protected within the Federal Columbian Forest Reserve, stand as the greatest natural resource of economic importance. But to the state and the nation the region finds its first value as a paradise for the tourist and nature lover.

Configuration and Lines of Ascent

From an altitude at the base of about 4,500 feet the snow-capped summit of Mt. St. Helens rises to an altitude of 9,761 feet above mean sea level (see Fig. 1). The shape of the mountain is that of a symmetrical cone with crestal angles figured from the crest for the highest and last mile as follows: (1) to the southwest in the direction of Butte Camp, 31½°; (2) to the northwest in the direction of Toutle River canyon, 27½°; (3) to the northeast in the direction of the headwaters of Smith's Creek, 23°; (4) to the southeast in the direction of the headwaters of Muddy River, 27°. Notwithstanding the fact that the angle of inclination from Butte Camp to the crest of Mt. St. Helens is, as shown above, slightly sharper, it is coincident with the trail most frequently taken by mountain-climbing tourists. The selection of this line of ascent is due principally to its accessibility. It is possible, how-

* The field work on which the data incorporated in this paper are based was done by the writer during the spring, summer, and autumn of the year 1915 while he was a member of a U. S. Geological Survey field party mapping the Mt. St. Helens quadrangle.

ever, as has been demonstrated, to climb the mountain from several angles.

The volcanism which found active expression as recently as the early part of the last century [1] has been responsible for the creation of a number

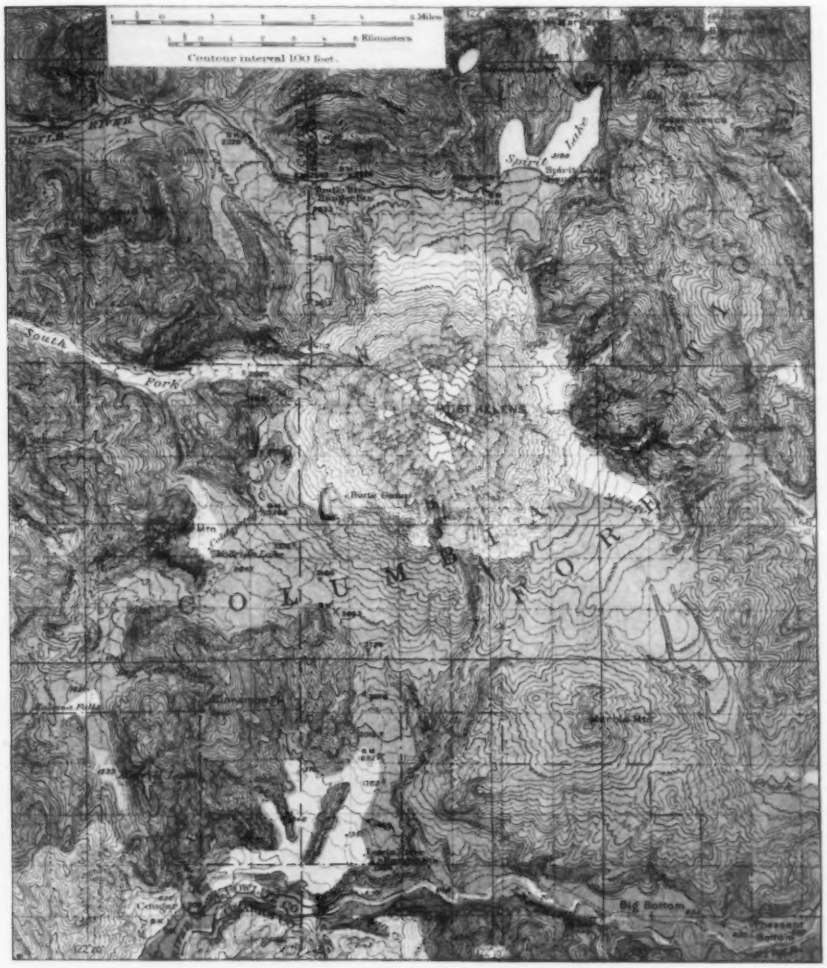

FIG. 1—Contour map of Mt. St. Helens. Scale 1:290,000. (Reproduced from the Mt. St. Helens topographic sheet, 1:125,000, of the U. S. Geological Survey, 191.)

of physiographic features which lend individuality to this old cone. Interesting as are the problems they present, these surficial peculiarities have as yet received little attention in geological and geographical literature.

[1] The Volcanic Activity of Mount St. Helens and Mount Hood in Historical Time. *Geogr. Rev.*, Vol. 3, 1917, pp. 481–485.

FIG. 2—Mt. St. Helens and Spirit Lake in early summer.

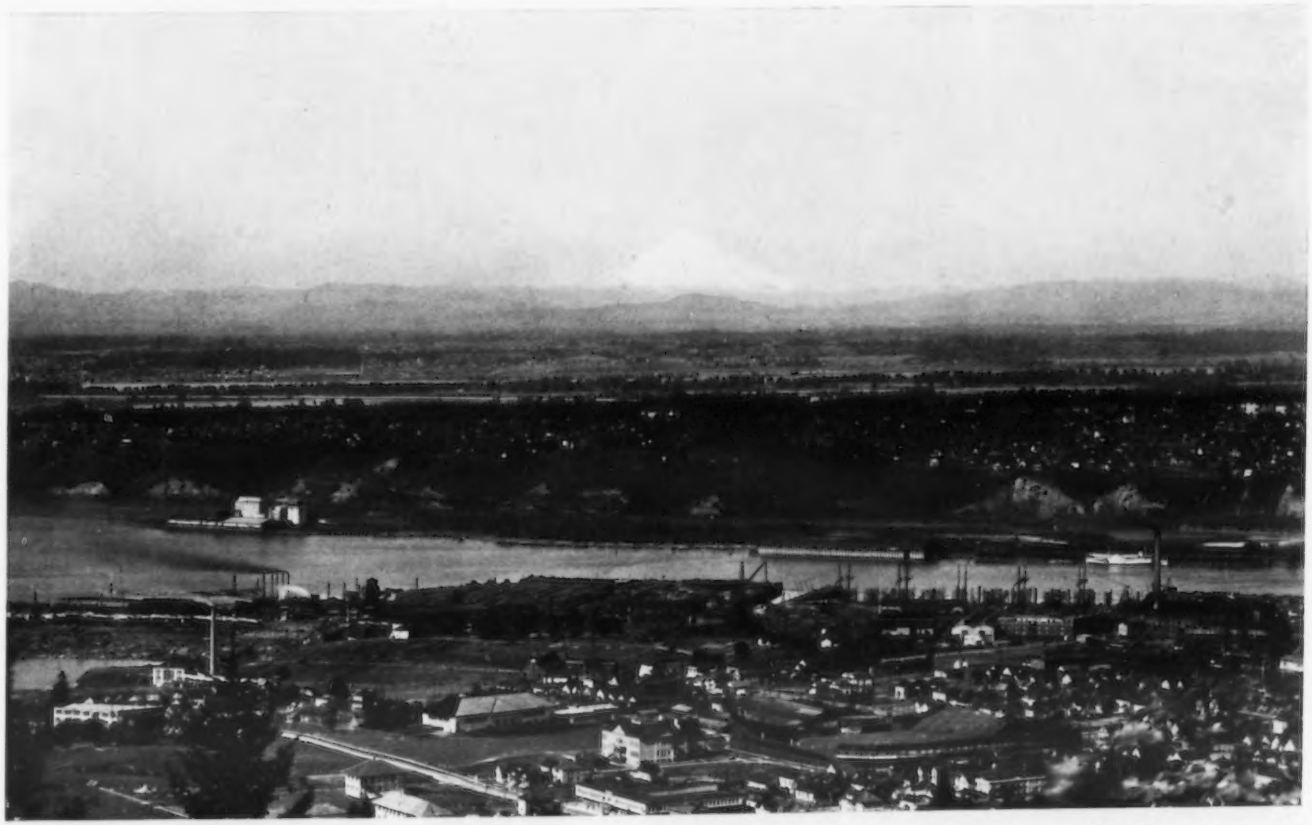

FIG. 3—Mt. St. Helens from King's Heights above Portland, Ore. The view is to the north, and the Columbia River in the middle foreground is flowing to the left. This view shows the symmetrical snow-capped appearance of Mt. St. Helens in the spring and fall.

Pyroclastic Deposits and Lake Formation

In the large amounts of pyroclastic materials and the succession of lava flows ample evidence may be noted of a rather extended period or series of periods of explosive and then quieter effusive eruptions. On the southwestern flank the headwaters of Kalama River from the vicinity of McBride Lake to below Kalama Falls have been buried under a very thick deposit of pyroclastic material, which, with other geologic agencies probably of an intrusive nature, have operated to dam up the waters of a northwestward-flowing branch of Kalama River and form Merrill Lake. This mountain pond has an elevation of 1,533 feet, is elongate in figure, and boasts two small rocky islands, uneroded ridges in the old valley. McBride Lake, located just to the east of Goat Mountain, and one or two other smaller ponds in this same vicinity were formed by the same deep deposit in which the Kalama River has cut for itself a deep, canyon-like channel.

The South Fork of Toutle River, flowing slightly to the north of west from Mt. St. Helens and fed in part by melting glacial waters, is entrenched deeply in a narrow boulder-clogged valley. There is a difference of relief of 2,500 feet from the Toutle River bed to Spud Mountain on the north and of 2,800 feet to Goat Mountain on the south. Both headwater branches of the South Fork of Toutle River head against the western slope of Mt. St. Helens proper in very precipitous canyons gouged out of fragmental débris several hundred feet deep.

Immense deposits of pyroclastics are to be found in the valley of the North Fork of Toutle River. The fill has been so general that an undulating river plain in many places over a mile in width has been developed. The river channel itself is boulder-choked and, like all of the streams heading in Mt. St. Helens, is very heavily overloaded. Great alluvial fans of fragmental materials, mostly of a very fine character, are found in the North Fork valley at the base of the mountain. Their development here has resulted again in effectually damming the headwaters of North Fork and producing the beautiful and widely known Spirit Lake. This little lake, with waters icy cold and sparkling, lies like a crystal emerald at the northern base of Mt. St. Helens. Its surface elevation is 3,199 feet, and, unlike Merrill Lake, it has a surface stream outlet.

Lava Deposits on the Eastern and Southern Slopes

On the eastern and northeastern side of Mt. St. Helens the original dendritic drainage of Smith's Creek, a southeastward-flowing tributary of Muddy River, approaches within three miles of the crest of the old volcano. The essential absence of volcanic fragmental materials and lavas on this side at elevations below 4,000 feet is conspicuous and interesting. On the southeastern and southern flanks of the mountain about the headwaters of Muddy River, Pine Creek, Swift Creek, all southward or southeastward-flowing tributaries of Lewis River, there is found the largest single expanse of volcanically modified physiography in the entire area. In this section

FIG. 4

FIG. 5

FIG. 4—View looking northward from Mt. St. Helens across Spirit Lake. Mt. Rainier is faintly seen in the far distance.

FIG. 5—Mt. St. Helens and Spirit Lake from the crest of Mt. Margaret, looking slightly west of south. The view from here shows clearly the consistent accordance of summit levels.

pyroclastics occur only in relatively insignificant quantity. This whole area, comprising between 40 and 50 square miles, is a broad southward and southeastward-sloping lava flow. The lava in many places is hundreds, perhaps thousands, of feet thick. It extends from the base of the mountain to the waters of Lewis River. At this point its rapidly increasing viscosity, induced by contact with the then swollen river, caused it to pile up several

FIG. 6—Overshadowing the surrounding hill country in height and magnificent grandeur, the snow-capped crest of Mt. St. Helens may be seen from practically every adjacent creek and valley. This view is from the Toutle River bottom land.

hundred feet in thickness in the debouchures of the former creeks and branches. The more liquid flows behind were ponded, and the crests of the former ridges were left as the only abrupt physiographic features of the immediate vicinity—rock islands in a sea of rocks. These broad and probably more or less quiet, though destructive, lava extensions distributed themselves between Marble Mountain (4,100 feet) and Cinnamon Peak (3,940 feet), which elevations are remarkable only as the highest points of the country rock presenting the original accordance of summit levels.

TOPOGRAPHY OF THE REGION

A careful examination of the topography, both in the field and as reproduced on the Mt. St. Helens quadrangle, reveals a region broadly uplifted

between 2,000 and 3,000 feet, with a somewhat poorly defined major axis about 20° east of north in the Mt. St. Helens vicinity. This axis will fall in line generally with Cinnamon Peak (3,940 feet); the crest of Mt. St. Helens and the lesser peaks to the immediate north; the Dome (5,703 feet); Mt. Margaret (5,847 feet); Mt. Whittier (5,818 feet); Goat Mountain (5,390 feet); Strawberry Mountain (5,732 feet); and Tumwater Mountain (5,249 feet)—the latter three of which form a portion of the southern watershed of Cowlitz River and its southern fork, Cispus River. Mt. St. Helens is located toward the southern extremity of this broad uplift, the first volcanic eruptions having broken out in the then headwaters of the South Fork of Toutle River.

Natural Phenomena of Interest to the Explorer

For the ardent explorer the Mt. St. Helens region offers many natural phenomena of interest besides the superb mountain scenery at every hand. If he goes in by the Lewis River post road with the mail he will stop at the end of a full day's travel at Cougar, which is a log cabin post office and the end of the route. Here the great southern lava flows with their old fumaroles and small gas cones are within a mile's walk. A climb of five hundred feet from the river level brings one to the top of the flow, where large areas of submerged forests are seen to have stood, the rough scoriaceous lava having filled in about them *in situ*. Where the great trees once stood the traveler will see hundreds of vertical or semi-vertical manholes in the former lava flood, now cold and partly moss-covered. If he examines closely these chilled lavas he will note that their surfaces are pitted and grooved as casts of the charred timber about which the cooling lava set into solid rock.

About a mile up the lava flow, at an elevation of 1,351 feet, occurs the lower entrance to the largest of the several lava caves of the Mt. St. Helens district. It is reported that this cave, which is really an elongate abandoned lava channel, is over a mile in length. This report, though it may be true, is not herewith authenticated. The lava cave trail will lead the mountaineer to McBride Lake or Butte Camp, if he cares to follow it, from whence he may easily make the ascent of the main elevation of Mt. St. Helens in one day, returning to Butte Camp for the night. He may then return over the Kalama River trail, passing by Kalama Falls and Merrill Lake where, if he cares to tarry, unsurpassable trout fishing may be found.

A more extended trip, and one of very great interest, takes the traveler to Lange post office on the shore of Spirit Lake north of Mt. St. Helens. The Toutle River trail, which swings to the north below Butte Camp, crosses the South Toutle River canyon at an elevation of 2,886 feet and continues almost due north to North Toutle River, whence it turns east three miles to Lange and Spirit Lake. On leaving Lange the traveler may either retrace his steps to Cougar or go out with the mail down the valley of North Toutle River to Castle Rock and Cowlitz River.

TIDE TABLES

By H. A. Marmer
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The tidal knowledge of the ancients appears to have been very meager; in fact, little mention of the tide is found in their literature. The chief maritime peoples of antiquity, living on or near the Mediterranean where the tide is small, could disregard it for practical purposes, and it likewise attracted little attention as a theoretical study. And, as with early explanations of other physical phenomena, the earlier attempts at explaining the tides were based largely on fanciful notions, such as the breathing of the earth and the power exerted by supernatural beings.

More rational theories ascribed the tide to differences in the level of the sea, to the discharge of rivers into the sea, to whirlpools and eddies, and finally to sun and moon. We have record of the fact that more than three centuries before the beginning of the Christian era the relationship between moon and tide had been noted. This relationship, however, received no rational explanation until the latter half of the seventeenth century when Newton formulated the law of gravitation and proved that the tides were one of its necessary consequences.

The ancients had little or no need for tide tables, and even until very recent times the navigator troubled himself little about accurate tidal data, for ships were operated on a schedule subject largely to the saving clause "weather and tide permitting." Now, however, an advance knowledge of the state of the tide is of great importance in maintaining an exact schedule at many places, since a change in the depth over the bar of but a few feet may mean the difference between getting a leviathan into port immediately or being compelled to wait several hours for a favorable tide.

Accurate tide tables became of prime importance during the World War; for in waiting for a favorable tide to enter port a vessel was exposed not only to possible bad weather but also to the more serious hazards of submarine attack. During the World War the importance of accurate tidal predictions was made manifest in other ways. In the case of a vessel being chased the navigator who had at hand accurate tidal data could decide whether a short cut over a shoal might be risked. During the bombardment of the Belgian coast the Allied war vessels were exposed to torpedo attack from the sea. By anchoring in the shoalest water possible considerable security was afforded, since if a torpedo was fired it was more likely to strike the shoal than the ship. That accurate tidal data were requisite for this purpose is evident from the fact that on the Belgian coast there is a range of from ten to sixteen feet in the rise and fall of the tides.

The oldest tide table of which there appears to be any record is one now

in the library of the British Museum. It is a manuscript table, apparently written in the thirteenth century, and gives the time of "flod at london brigge"—the time of high water at London Bridge. The modern navigator would scarcely recognize this as a tide table, for the times of tide are given not for calendar days of the month but only with reference to the moon's age. Of the modern tide tables the first appear to have been published by the British Admiralty in 1833. These tide tables gave the predicted times of high water only. In 1839 the French Hydrographic Service began the issue of its "Annuaire des Marées," and in 1853 the U. S. Coast and Geodetic Survey published its first tide tables.

Each of the leading maritime nations now publishes tide tables annually, a year or more in advance, for the use of its navy and merchant marine. For our own country this important work devolves upon the Coast and Geodetic Survey which early in May of every year issues the tide tables for the whole of the following year. These tide tables now cover the entire maritime world and give for every day of the year the predicted time and height of high and low water at eighty-one of the more important ports of the world. In addition these tables also contain sufficient tidal data for some thirty-five hundred secondary ports, which, in connection with the daily predictions given for the principal ports, enable the American navigator to make use of any port in the world.

Underlying Principles

The tides, as is well known, are due to the gravitational action of sun and moon upon the rotating earth. The moon is the principal agent, or as the popular expression has it, "the tide follows the moon." This is due to the fact that the tide-generating force of a body varies directly as its mass and inversely as the cube of its distance from the earth. The sun has a mass almost 26,000,000 times as great as that of the moon, but because its distance from the earth is 389 times that of the moon's, its tide-producing power is to that of the moon as 26,000,000 is to $(389)^3$ or somewhat less than half.

While the mathematical expression for the tide-generating forces of the sun and moon may be derived without difficulty, the tides as they actually occur in nature have been so profoundly modified by terrestrial features as to bear little or no resemblance to the purely theoretical tide. In other words, while the tidal *forces* for any point on the earth may be computed from a general formula based on astronomical considerations, it is not possible to derive such a general formula for determining the time and height of tide. The tides at places but a short distance apart may be very dissimilar. To take but a single example: at the Atlantic end of the Panama Canal the tides have a rise and fall of about one foot, and at certain times of the month but one high and one low water occur during a day; at the Pacific end the rise and fall is from twelve to sixteen feet, and every day

there are two high and two low waters. The tides, then, are local phenomena, and the first step in the making of a tide table for any given port is to secure tidal observations at that port for a period varying from a month to a year or more. These observations may then be treated in two different ways known technically as the nonharmonic and harmonic methods. The former method is the simplest and the one used in the making of the earlier tide tables.

The Nonharmonic Method

This method is based on the close relationship existing between the time of tide at any given place and the moon's meridian passage. It begins by determining, from observations made at the port for which predictions are desired, the intervals elapsing between the moon's meridian passage and the times of tide. These time intervals, known respectively as the high-water and the low-water lunitidal intervals, have an approximately constant value for any given place and after having been once determined, say from a month or more of observations, may be used for making a rough tide table for that place by adding to the times of the moon's meridian passage as given in a nautical almanac.

The lunitidal intervals at any given place, as stated above, are only approximately constant. During a lunar month they undergo periodic changes, depending principally on the phase and declination of the moon. From long series of tidal observations these periodic changes may be determined; and by using these as corrections to the lunitidal intervals satisfactory predictions may be secured. It was by various modifications of the method as above outlined, with corrections for inequalities in the motions of sun and moon, that tide tables were computed for many years.

The heights of high and low water were predicted in a similar manner. The average heights for high water and for low water at the port for which predictions were desired were determined from observations. To the average heights corrections were then applied for changes in the phase and parallax of the moon, these corrections likewise being derived from observations. The tide tables produced in this way, although only approximately correct, worked quite satisfactorily for the Atlantic coast of the United States and for Europe. However, when applied to the prediction of tides of a different type, such as are found in the Pacific and Indian Oceans, the nonharmonic method necessitated so many corrections as to become prohibitive.

Types of Tide

The different varieties of tides occurring in nature may be divided into three types: semidaily, daily, and mixed. In the semidaily type, as its name indicates, there are two high and two low waters each day, high water and low water following each other at intervals of approximately six hours, the morning and afternoon tides being similar. To this type belong the tides on the Atlantic coasts of the United States and Europe.

At many places—as for instance: St. Michael, Alaska; Manila, Philippine Islands; Batavia, Java—we find a totally different type of tide. Here high water and low water will frequently be more than twelve hours apart; or, in other words, instead of two high and two low waters in a day, as on the Atlantic coast, there will be but one high and one low water in a day. To this type of tide the name "daily" has been given.

As a matter of fact, there is no place known where the tide is always of the daily type. At all places where this type predominates periods of one

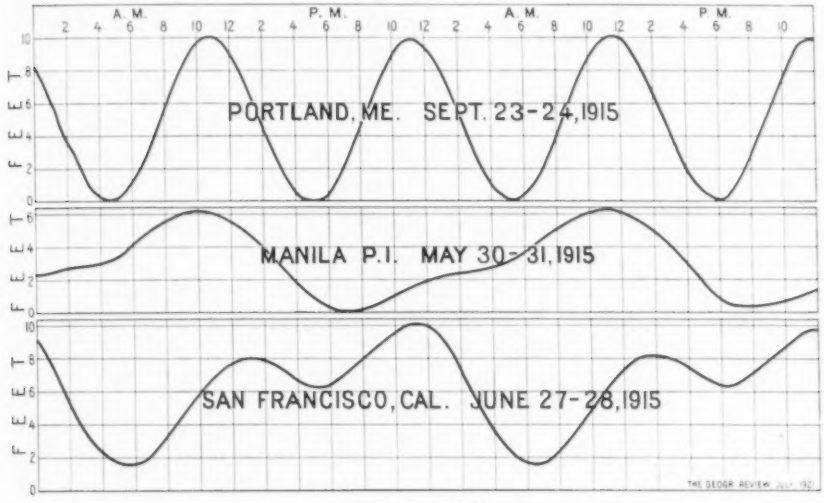
A. M.
P. M.
A. M.
P. M.
2 4 6 8 10 12 2 4 6 8 10 12 2 4 6 8 10 12 2 4 6 8 10
FEET
PORTLAND, ME. SEPT. 23-24, 1915
MANILA P.I. MAY 30-31, 1915
SAN FRANCISCO, CAL. JUNE 27-28, 1915

FIG. 1—Types of tide.

or more days occur during which there are two high and two low waters each day, these periods coming about the time that the moon's declination is changing from north to south or south to north. But, though two high and two low waters occur, they differ strikingly from the semidaily type in that the morning and afternoon tides are unlike both in extent and in duration of rise and fall. Such tides, having two high and two low waters each day but with morning and afternoon tides differing considerably, are known as the mixed type. This is the prevailing type on the coasts washed by the Pacific and Indian Oceans.

In the accompanying diagram the three types of tide are illustrated by plottings of hourly heights of the tide as observed for a period of two days in 1915 at Portland, Me., Manila, P. I., and San Francisco, Cal.

The tide curve for Portland exemplifies the semidaily type of tide. Beginning with the low water about 5 A. M., September 23, the water rises for a period of about six hours, falls for a like period, and repeats the cycle again in the afternoon and similar cycles the next day. In each case the rise or fall is about ten feet and takes place during an interval of about

six hours; in other words, both in extent and in duration of rise and fall the morning and afternoon tides are similar; and this is typical of the semidaily tide.

At Manila the tide is predominantly of the daily type, that is during the greater part of the time but one high water and one low water occur daily. Thus on May 30, 1915, high water occurred about 10 A. M., low water about 7 P. M.; and the next day likewise there occurred but one high and one low water.

The mixed type is illustrated by the tide at San Francisco for June 27 and 28, 1915. On both days we have two high and two low waters, but there is a striking difference between morning low water and afternoon low water and between morning high water and afternoon high water. This difference between morning and afternoon tides is of a twofold character: the extent of rise or fall is unlike and the duration of rise or fall is unequal. This difference between the two tidal cycles of the day is what distinguishes the mixed type of tide from the semidaily type.

For predicting the semidaily type of tide the nonharmonic method, as previously stated, gives satisfactory results. When applied to the prediction of the mixed type of tide this method, even where successful, necessitates an increase in the number of corrections to give passable results; but when tried for ports where the tide frequently becomes daily it falls down badly. Before the need for accurate tide tables covering the whole maritime world became pressing, a more effective method of treating and predicting tides was introduced. This, known as the harmonic method, is now used in the preparation of the tide tables issued by the United States government.

The Harmonic Method

If the motion of the moon around the earth and that of the earth around the sun could be made to take place in circular orbits in the plane of the equator with earth and sun as centers respectively, and, furthermore, if the lunar month consisted of an integral number of solar days, tidal prediction would be a very simple matter. It would only be necessary to observe the tides at any given port for a lunar month, and these observations would then constitute a very exact tide table for that port for the future; for the tide of any day of a lunar month would be exactly similar to the tide of the same day of any other lunar month. The actual motions of sun and moon are complicated; they can, however, be resolved into simple components; and this is what is done by the harmonic method. It substitutes for the sun and moon as tide-producing agencies a number of simple hypothetical bodies which, with respect to the earth, have circular orbits in the plane of the equator. Each of these tide-producing bodies is assumed to give rise to a tide of its own kind, and the tide as it actually occurs in nature is thus considered as being made up of a number of simple tides each of which has a period corresponding to the period of its particular, hypothetical tidal body.

The periods of revolution of the assumed tidal bodies, and therefore the periods of the simple constituent tides, are determined by astronomical calculations from the known motions of the moon and sun. These periods being independent of local conditions are therefore the same for all places on the surface of the earth; what remains to be determined for the various simple constituent tides is their phases and amplitudes, which vary from place to place according to type, time, and range of tide. The mathematical process by which these phases and amplitudes are disentangled from tidal observations is the very ingenious method known as harmonic analysis and is due to the brilliant and versatile physicist, William Thomson, better known as Lord Kelvin, who first proposed it in 1867.

FIG. 2—Tide-predicting machine. On the machine the amplitudes of the constituent tides are set out on cranks, and the phases on dials. The height of tide due to any constituent tide is then given by the vertical motion of a slide on which is fixed a pulley with a chain working in the groove. This chain is made to travel over all the pulleys and thus sums instantly the constituent tides.

We cannot here enter into a detailed discussion of harmonic analysis. Unlike the nonharmonic method, which makes use of high and low waters only, the harmonic method makes use of the whole tidal wave, that is it uses hourly heights of the tide. The process, while not difficult, necessitates somewhat involved mathematical computations, out of which emerge the phases and amplitudes of the constituent tides sought. Though the theoretical number of these simple constituent tides is large, most of them are of such small magnitude that only between twenty and thirty need be computed to give tidal predictions of a high degree of precision.

TIDE-PREDICTING MACHINES

Now it is obvious that the period, phase, and amplitude of a simple constituent tide being known, it is not a difficult matter to find the height of

tide due to that constituent at any given future time. Hence, to predict the tide that will occur at some future time, it is only necessary to add together the heights of the constituent tides at that time. The labor involved in doing this by ordinary methods of computation, however, is so great as to be prohibitive. In 1872 Lord Kelvin devised a machine which mechanically effects the summation of all the various tidal components and thus put tidal prediction by the harmonic method on a practical basis.

For the United States the tide tables until 1885 were predicted by the nonharmonic method; but in that year a tide-predicting machine, constructed on plans devised by William Ferrel, of the Coast and Geodetic Survey, and based on the harmonic method, was put into operation. This machine differed considerably from that devised by Lord Kelvin and was well adapted for predicting the semidaily type of tide. For more complicated tides the Ferrel machine did not work so well. In 1912 it was superseded by a new tide-predicting machine, devised and constructed in the office of the Coast and Geodetic Survey. A view of this machine is shown (Fig. 2). It has been described in the Survey publication entitled "Description of the U. S. Coast and Geodetic Survey Tide-Predicting Machine No. 2."[1] By the new Coast and Geodetic Survey tide-predicting machine a tide table giving the time and height of every high and low water for every day of the year for any port can be made in about ten hours.

Accuracy of Tidal Predictions

Obviously the value of a tide table depends on the closeness with which the predictions agree with the tides as they actually occur. It is evident, however, that absolute agreement is quite out of the question, for the times and heights of the tide are modified to a considerable extent by prevailing meteorological conditions. Heavy winds and sudden changes of atmospheric pressure will affect both time and height of tide; and, until the meteorologist is in a position to predict, a year or more in advance, the exact meteorological conditions that will prevail, the predicted tides in the tide tables cannot take account of such changes. Corrections based on local knowledge, however, may be applied to the predicted tides to allow for changes in wind and atmospheric pressure.

As a test of the accuracy of tidal predictions, observations and predictions at Portland, Me., and Seattle, Wash., were compared for the months of May and November, 1919. At Portland the tide is of the semidaily type and has a rise and fall varying from seven to thirteen feet. At Seattle the tide is of the mixed type with a rise and fall varying from less than two feet to more than sixteen feet.

At Portland for the month of May the greatest difference between the predicted and observed times of tide was four-tenths of an hour, or about twenty-five minutes. For the whole month 59 per cent of the predicted

[1] *U. S. Coast and Geodetic Survey Special Publ. No. 32.* Washington, D. C., 1915.

times differed by not more than one-tenth of an hour from the observed times of tide, and 94 per cent by not more than two-tenths of an hour. For November 74 per cent of the predicted times differed by not more than one-tenth of an hour, and 97 per cent by not more than two-tenths of an hour—the greatest difference again being four-tenths of an hour.

At Seattle for May 56 per cent of the predicted times of tide differed by not more than one-tenth of an hour from the observed times, 78 per cent by not more than two-tenths of an hour, and 99 per cent by not more than three-tenths. Here, too, the greatest difference was four-tenths of an hour. For November 47 per cent of the predictions differed from the observations by not more than one-tenth of an hour, 78 per cent by not more than two-tenths, 99 per cent by not more than three-tenths; while the greatest difference was four-tenths of an hour.

It should be stated that no corrections were applied to the predicted times of tide for changes in meteorological conditions. Furthermore, it is to be remembered that near the times of high and low water the height of the tide is changing very slowly and that it is not practicable to determine the time of the observed high or low water with a precision greater than that represented by a tenth of an hour. Therefore a difference between observations and predictions of two or three-tenths of an hour is of little consequence, especially for practical purposes.

The study of the tides has engaged the minds of many brilliant mathematicians since the time of Newton and still constitutes a fertile field for investigation. The outstanding problems do not relate to the determination of the tidal forces, for these are known; they are altogether of a hydrodynamical character and are concerned with the motions of existing bodies of water as influenced by known tidal forces. As regards the prediction of tides, however, in so far as this is based on previous observations, the problem may be considered solved.

NEW ORLEANS AT THE TIME OF THE LOUISIANA PURCHASE [1]

By Edna F. Campbell

At the time of the Louisiana Purchase (1803) population in the United States was, with a few exceptions, largely confined to the Atlantic seaboard. Among the exceptions was New Orleans, which was the focus of the life of the Mississippi Valley, as indeed it had been since the early days of settlement. The New Orleans of these early days has been sketched in a previous article.[2] Development of the town was slow despite the natural productivity of the region which made for a certain ease of life. Colonial policy both under the French and the succeeding Spanish domination was unfavorable; and, furthermore, the colonists suffered from certain natural handicaps. Uncertainties of weather affected the crops, notably indigo, which for a time was the staple cultivation. The topographic conditions of swamp and forest impeded expansion, and still more powerful was the factor of geographic isolation.

In the Mississippi Valley all roads led to New Orleans, and the ease of reaching its markets was a powerful deterrent to the growth of other towns

[1] The main sources used are:

An Account of Louisiana, 1803. Being an Abstract of Documents in the Offices of the Departments of State and of the Treasury, *Old South Leaflets*, Vol. 5, pp. 89–116, Directors of the Old South Work, Boston, 1902.

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Charles Sealsfield: The Americans As They Are: Described in a Tour Through the Valley of the Mississippi, London, 1828.

Amos Stoddard: Sketches, Historical and Descriptive, of Louisiana, Philadelphia, 1812.

[2] Edna F. Campbell: New Orleans in Early Days, *Geogr. Rev.*, Vol. 10, 1920, pp. 31–36.

in the "Delta." As commonly spoken of by the writers of this period, the country south of the Atchafalaya-Red confluence on the right side of the Mississippi River was the "Delta." In this section the valley west of the river is many times larger than the eastern part, and in no place is the river bordered by bluffs. Natural levees and the scattered prairies afforded locations for settlers.

Distribution of Population in Lower Louisiana

At the time of the cession three-fourths of the population and seven-eighths of the wealth of Louisiana were concentrated in the Delta. It is somewhat difficult to give precise figures. Estimates vary widely; probably in large part because of the character of the population, only about half of which was regularly settled. The population of Lower Louisiana (i.e. south of latitude 31° N. and from the Perdido River to the Sabine River) may be placed at about 60,000, exclusive of Indians.[3] Rather more than half, about 32,000, occupied the margin of the Mississippi; and of these between 8,000 and 12,000 were in New Orleans. The La Fourche region and the strip extending through Bayou Sara, Natchitoches, and Avoyelles each had about a tenth; the prairies of Opelousas and Attacapas contained nearly a fifth. The remainder occupied the high land in the vicinity of Lake Pontchartrain. Of this population little less than half were whites. The percentage of the blacks was rapidly increasing as the restrictions on their importation were being lightened. In more detail the distribution may be characterized as follows.

From Pointe Coupée parish, below the egress of the Atchafalaya from the Mississippi, settlements were continuous on the right side of the river to within 20 leagues of the Gulf. On the left, plantations beginning a short distance below Iberville bordered the river to about the same distance from the Gulf and about 27 miles below New Orleans. Sixty miles below New Orleans were Fort Plaquemine on the one side and Fort Bourbon on the other, marking the limit of settlement. At this point the swampy morass set a barrier to further extension. Settlement was such on both sides of the river as to give the appearance of a continuous village along the entire strip, but it was thinner on the right than on the left side. The best plantations were above and near New Orleans on the left side. On an average of about half a mile to a mile back from the river the plantations gradually merged into impassable cane and cypress swamps. The levees bordering the numerous bayous also afforded opportunity for settlement. Of such, three were of chief importance. The La Fourche had 200 families, mostly poor Spanish, scattered along its banks for some 45 miles. The Plaquemine, flowing from the Mississippi about 30 miles farther north, and the Atchafalaya, 130 miles still farther north, were similarly settled.

[3]Robertson, Vol. 1, pp. 149–150.

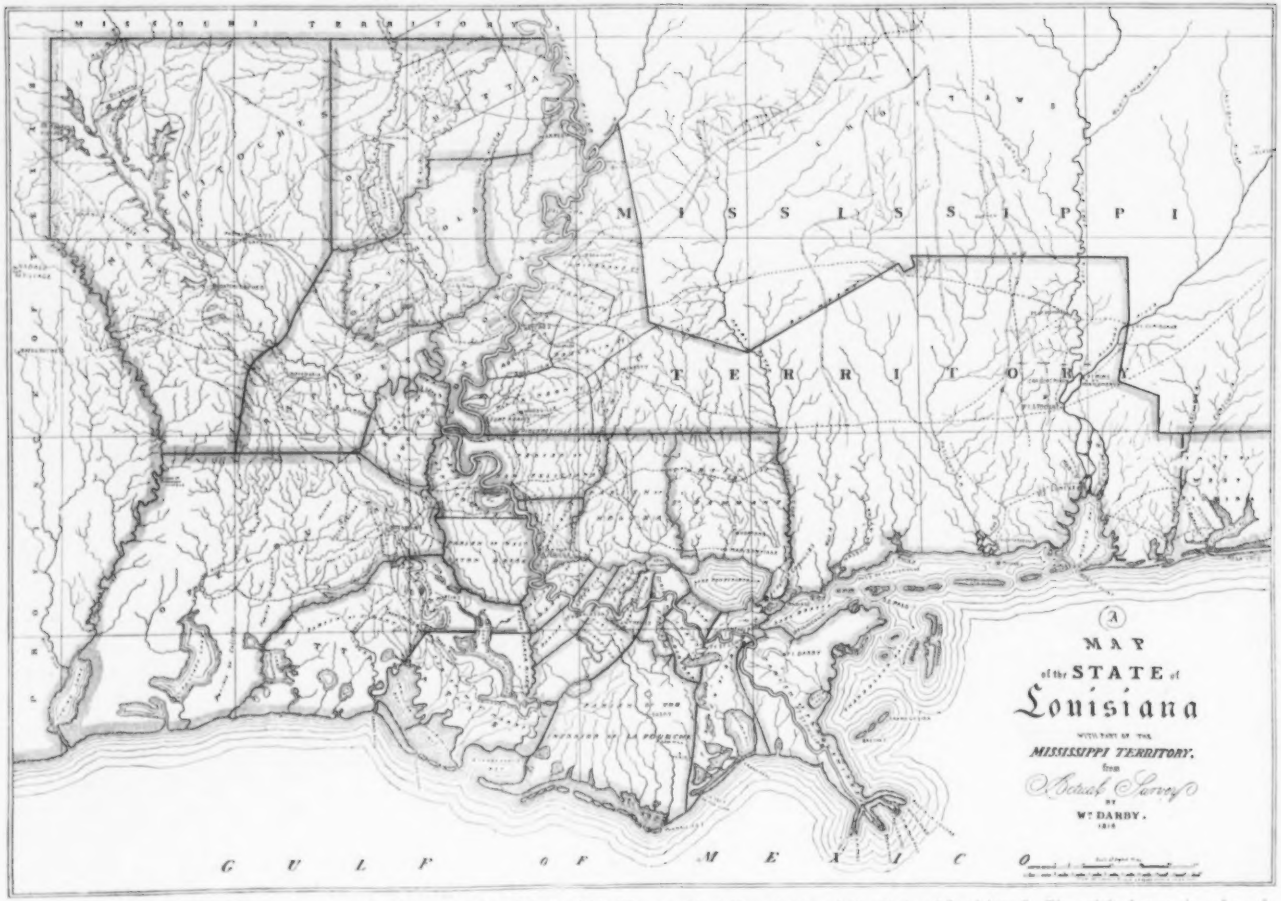

FIG. 1—Darby's map of Louisiana accompanying the first edition (1816) of his "Geographical Description of the State of Louisiana." The original map is 32" x 44".

Along the Plaquemine only the left 20 miles below the efflux of the Atchafalaya were settled; elsewhere the danger of inundation precluded settlement.

On the east side of the valley similar conditions of bordering levees, cane swamps, and salt marshes existed throughout the area, with the exception of a dry strip of excellent land about a mile in width, extending from the Mississippi some ten or twelve miles below New Orleans eastward to the lakes. Here there was a poor settlement, known as Terre aux Boeufs, composed of about 800 Spanish who raised produce for New Orleans. The wealthy planters occupied the alluvial margin of the Mississippi, where the most valuable lands were on the projections of the river curves.

To the west and southwest of the Mississippi the "Coasts" of Opelousas and Attacapas were a network of bayous and swamps[4] interspersed with strips of prairie. Opelousas covered about 7,600 square miles, and Attacapas 5,100, while other small coasts were Calcasieu, Grand, and Mamon. Most of the inhabitants of Attacapas lived along the Teche and the Vermilion. Of a great number of Americans who came into the region after the Purchase, many entered by way of the Atchafalaya; for it was estimated that the distance from the western states to the Gulf could be shortened more than 120 miles by descending that stream rather than the Mississippi. Furthermore, it was easier of entry.

Growth of Population

Pontalba had urged in 1800 that what was needed in Louisiana was working hands.[4] His contention was proved in the early years of the century. In the twenty-five years preceding 1810 the population more than doubled, rising from 37,000 in 1785 to nearly 76,000 in 1810;[5] and by 1820 to almost 154,000.

The remarkable growth was chiefly due to the opening up by the Purchase of a vast extent of fertile land. Here was an opportunity for the restless Americans in the period following the Revolution. Emigrants came especially from Kentucky, Tennessee, Georgia, western Pennsylvania, and the Carolinas. Excitement connected with Burr's movement on the Mississippi River brought hundreds to the valley. Refugees from war-harassed Europe added to the number. Much advertising was given the region by numerous publications, especially Jefferson's widely circulated pamphlet, the "Account of Louisiana." The majority of incomers were engaged in commercial pursuits, and such crowded along the Mississippi. The second great class of immigrants came to make homes and started their little plantations wherever was available fertile soil, combined with sufficient elevation for protection from flood.

Fig. 1—Darby's map of Louisiana accompanying the first edition (1816) of his "Geographical Description of the State of Louisiana." The original map is 33" x 44".

[4] Gayarré: History of Louisiana: The Spanish Domination, pp. 410–415.

[5] Timothy Flint: The History and Geography of the Mississippi Valley, Vol. 2, p. 233.

Pastoral Lands

The borders of the swamps were suitable for cattle and swine to range, and immense herds of cattle and horses and large flocks of sheep ranged the prairies as well. Darby spoke of these prairies as among the "meadows of America." The *vacheries*, as they were called, were the greatest in the United States by 1810. As many as 15,000 to 20,000 head of cattle and horses were brought from the Spanish provinces to North America, and Spanish methods in caring for them were used. Conditions were favorable for such an industry. Salt was cheap, being obtained from wells sunk in the Petite Anse hill along the coast. Wells fifty feet deep supplied water, as that from fresh springs on the prairie was inadequate. The meadows furnished an abundance of food, and little shelter was needed. It was estimated that the value of a *vacherie* doubled every four years, and that of a cotton plantation every three years.[6]

Agriculture

Preparation of the ground for planting was a more difficult matter than in the north, necessitating more labor and hence more capital. If it were not a canebreak bottom, clearing involved the burning of a dense undergrowth of shrubs, thistle, and thorns. Cotton and sugar were the staple crops. Within a hundred miles north and fifteen miles south of the city sugar was the great crop. An acre of cane produced from 1,000 to 1,200 pounds of sugar and 50 gallons of rum. The sugar crop of 1802 yielded 5,000 hogsheads of 1,000 pounds each of sugar and 5,000 casks of molasses of 50 gallons each.[7] At the time of the American occupation there were between 60 and 80 sugar plantations in the valley, and of these more than three-fourths were above New Orleans.

Cotton was grown widely, but the best sections were the upper part of Baton Rouge, Attacapas, Opelousas, and Pointe Coupée. Little else was grown by the rich and populous settlement of the last-named section. The cotton was fine but of short fiber. About 250 pounds, valued at 20 cents a pound, were grown on a single acre. In 1803 the production was 20,000 bales of 300 pounds each.[8]

In other parts of the valley the planting was more varied. Proprietors of large plantations grew cotton, while the owners of the smaller ones, many of whom were Germans, planted rice. Because of the need of water for flooding the fields, rice was grown only near the streams.

Agricultural Trends in Colonial Days

A gradual evolution in agriculture had taken place in the valley. The chief crop of the first French planters had been indigo, a cultivation well

[6] Stoddard, pp. 182–183.
[7] Monette, History of the Discovery, etc., Vol. 1, p. 566.
[8] Martin, Vol. 2, p. 234.

adapted to the character of the land, for the vigorous taproot of the plant easily penetrates hard, packed, marly soil. The crop, formerly reaching a total of 300,000 pounds, was reduced by the year 1800 to 100,000 pounds and thence diminished rapidly, amounting to only 3,000 pounds in 1803.[9] The year of the locusts, 1794, had marked the climax of indigo production, after which cotton came gradually to replace it. There were other factors involved in the change. The damp climate of Louisiana was unfavorable. A glut of indigo on the European market lowered prices, and at the same time use of the saw cotton gin and advance in cotton prices favored the latter production.

Although indigo was abandoned by most of the planters, it still was grown by some, for there was prevalent a belief that a rotation of sugar and indigo made the planting of the latter practicable. The impression was current that the sugar cane destroyed the insects that were fatal to the indigo.

There was a further tendency to replace cotton by sugar where climatic conditions were favorable. A writer in *Niles Weekly Register*, commenting in December, 1815, on the change from cotton to sugar, spoke of the cane as more desirable, "being less liable to disease and accident, and requiring less labor to bring it into market, one acre in cane being also equal in value to three acres in cotton." "The Navigator" credits the planters with the statement that one-fourth of the cultivated land of any considerable plantation may be planted in cane, one-fourth left in pasture, and the other half used for provisions, etc., and a reserve for a change of crops.[10]

An economic evolution paralleled the agricultural. Indigo, cotton, sugar involved, in turn, greater capital. The first Americans to come into the valley after the Revolution were poor. Indigo required the least capital and labor of the three great staples. A gradual accumulation of money made possible the purchase of slaves, an increase in extent of landholdings, and the profitable cultivation of great cotton and sugar plantations. Consequently sugar was planted by the more wealthy proprietors and cotton by the poorer.

At the time of the Purchase there still persisted the belief that the valley held possibilities in the culture of the vine and the olive; for the similarity in climate to that of southern France was yet in mind. To test the possibility, the United States Government granted a tract of land to a company of French immigrants on condition that they should "introduce the culture of the vine and olive." In a discussion of the project, a writer of the period remarked "that from the time the ark rested on Mt. Ararat to the present day, wine has never been made to any great perfection upon the alluvial soil of large rivers." [11]

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[9] *Ibid.*, Vol. 2, p. 234.

[10] Cramer, p. 338.

[11] Darby, The Emigrant's Guide, etc., p. 22.

New Orleans As a City

The valley was conspicuously a one-city region, no other center than New Orleans having as much as one thousand population. New Orleans owed its importance principally to its situation. The site, on the other hand, had many disadvantages. It was low; and the inhabitants, especially during the weeks of early summer, lived in fear of the river. Breaks in the levee were frequent. The expense of its repair and maintenance was high but was met in part by an anchorage duty of six dollars. Problems of sewage disposal and water supply were likewise serious. It was to conditions of filth, lack of drainage, and improper living that the contemporary writers attributed the prevalence of disease, for it was agreed that the climate was wholesome. Yellow fever did not appear in the valley until 1767. The disease was unknown in the country districts, where large families and longevity were the rule.

The situation of New Orleans offered compelling commercial advantages. It commanded the trade of the Mississippi River system, which included a maze of bayous that linked it with every settlement. It was the outlet for a fertile, almost level country more than 1200 miles in length from north to south and averaging 200 miles in width. It was only a short distance from the sea, at this period about 100 miles, and was accessible to ocean vessels. Trade with the West Indies and Mexico, for which the port was conveniently placed, was important at this time.

Furthermore, New Orleans was a double port, the second connection being furnished by the Carondelet Canal by means of which easy access was given to the region immediately to the northeast and an important source of lime, tar, pitch, lumber, and fish. The harbor was good. Its crescent shape afforded protection, as in the case of Natchez. Tides had little or no effect, but the depth of the river permitted the discharge of cargo by means of a bridge supported by two forty-foot spars.

Other Population Centers

Excepting Natchez, all other centers were purely local. The occasion of each was the parish church, and the geographical feature that determined its site was either the high land of a levee margining the stream that provided transportation, or the intersection of an upland prairie by such a channel or by one of the few roads in the valley, or the junction of two of the streams.

By 1810 the only towns in the Delta other than New Orleans, worthy of the name, were Madisonville, the port on Lake Pontchartrain, at the junction of the Amite and Iberville; Donaldsonville, at the efflux of the La Fourche; Springfield, a resting place between Natchez and Madisonville; and Baton Rouge.

Industrial Conditions

At the time of the Purchase, there were but few manufactures. These were connected largely with the agricultural products and were of the most

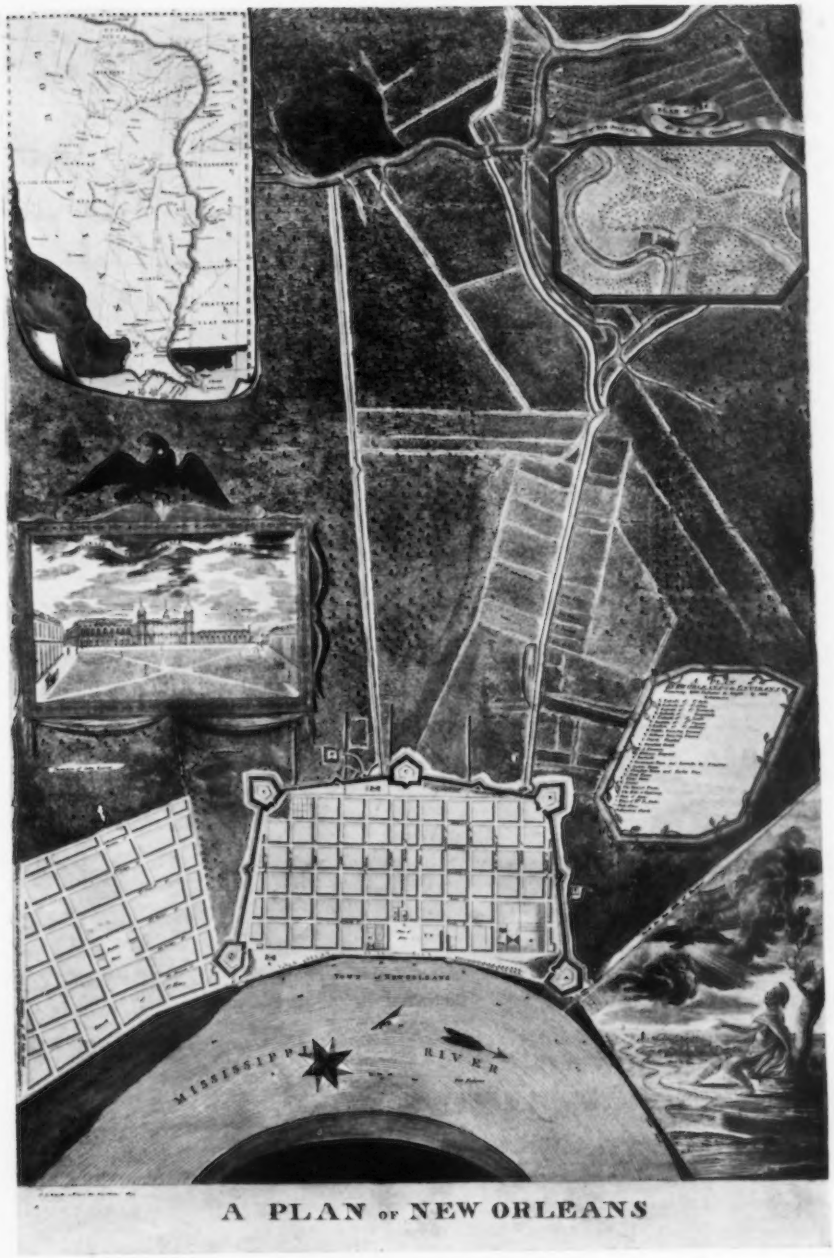

FIG. 2—Boqueta de Woiseri's plan of New Orleans in 1803. The original is 18¼" x 27".

primitive kind. Exorbitant prices of foreign manufactured textiles encouraged domestic industry. Women slaves were employed in spinning and weaving, and men slaves as carpenters and smiths. There were but two machines for spinning cotton, one in Opelousas and one in the parish of Iberville, and these were not always in operation.[12] In the suburbs of New Orleans there was a cotton mill capable of cleaning and baling a thousand pounds of cotton daily. This was one of the large public cotton gins in the valley. To such gins the proprietors of small plantations in the lower part of the valley brought their cotton. At New Orleans there were also a cordage factory and several factories for shot and for hair powder.

The great stock farms of Opelousas and Attacapas gave rise to an important tanning development. Little dairy produce was made in that section, however. Most of the surplus butter and cheese came from the Red River district, from which much was exported.

Aside from cotton ginning and the tanning of hides, the only industries of any significance were sugar refining and lumber milling. In 1796 there were 10 sugar refineries in the valley.[13] One of these, located at New Orleans, produced yearly about 200,000 pounds of loaf sugar. Tafia, a kind of rum, was an important by-product. In the vicinity of New Orleans there were 12 distilleries, manufacturing more than 200,000 gallons yearly. Rapid expansion of sugar planting and the influx of a large number of refugees from Santo Domingo skilled in the manufacture of sugar led to a rapid growth of refining.

The most important industry at this period was the milling of lumber and the making of boxes for shipping sugar. In the slack season of autumn planters sent their slaves to the cypress swamps in the rear of their plantations. The squared timber was floated down the Mississippi by means of ditches cut through the swamp for the purpose. As the nearer sources were exhausted much timber also was cut from the unclaimed cypress swamp between New Orleans and Pointe Coupée and was floated on rafts down to New Orleans. Planters cut mill races through the levees and erected mills on them which, during flood time, were worked night and day. There were about 30 of these mills near New Orleans. Boxes, most of which were exported to Cuba and Havana, brought a revenue of more than $100,000 yearly to the planters.[14]

Much timber, especially cypress[15] which was much in demand for building purposes, had been taken from the islands in the river by the beginning of the nineteenth century. It is interesting to note that as early as that time a writer commented on the taking of timber from public lands as improper and urged that an effort be made to prevent the wasteful use of lumber. This was probably one of the first suggestions for the conservation of timber in this country.

[12] Martin, Vol. 2, p. 234.
[13] Robertson, Vol. 1, p. 154.
[14] Gayarré, History of Louisiana: The Spanish Domination, p. 439.
[15] Darby, A Geographical Description, etc., p. 74.

Commercial Conditions

Commerce in the region, up to this time, was one-sided. Exports, though gradually increasing during the later colonial period, never equaled imports in value. The year before the Purchase exports by way of the sea amounted to about $2,160,000, and imports to $2,500,000.[16] As New Orleans was the port of the entire western country the total exports, amounting to nearly 40,000 tons, included part of that output as well. The principal items were flour, 50,000 barrels; tobacco, 2,000 hogsheads; salt beef and pork, 3,000 barrels; cotton, 34,000 bales; molasses, 800 casks; sugar, 4,000 hogsheads; peltries, naval stores, and lumber.[17]

Commercial relations were established not only with European countries but with Cuba, Santo Domingo, and American towns as well. The latter commerce included a coasting trade with Atlantic and Gulf ports and an exchange with the western country.

Until 1800, French vessels made exchanges chiefly with Bordeaux, Marseilles, and Nantes. By 1802, American and Spanish vessels had largely replaced the French.[18] The rapid increase in sugar and cotton planting led to more than a tenfold increase in the number of vessels.

The small commerce reflected the small production, which was limited to lumber, agricultural products, and furs. The English had managed to secure control of the fur trade, and the Spanish had no great incentive in that direction, as furs were not in great demand in Spain. Not until the great staples, sugar and cotton, began to dominate the planting was there an important agricultural surplus.

Down-river trade at the close of the period preceding the steamboat was estimated at $15,000,000. Besides this about 50,000 bales of cotton and 15,000 hogsheads of sugar from Mississippi and Louisiana were exported from New Orleans. Exports from New Orleans averaged $2,000,000. At the same period about 500 vessels entered yearly from domestic and foreign ports.[19]

Traffic on the Mississippi River

The basis of early French settlement in North America was the fur trade, and, in the absence of roads, the superficial exploitation of the country was based on the streams, on whose borders all the settlements were to be found.

Until 1720 it was largely furs that made up the cargoes on the Mississippi and its tributaries. About this time the nature of the traffic changed. The Illinois colonists in the southern end of the valley needed the foodstuffs produced above. To the growing town of New Orleans French ships were bringing merchandise and supplies, making it the commercial center of the valley. To handle the resulting trade barges, "keels", and flatboats were used.

[16] Stoddard, p. 296.
[17] Martin, Vol. 2, p. 236.
[18] *Ibid.*, Vol. 2, p. 234.
[19] Monette, The Progress of Navigation, etc., p. 515.

The long, narrow keel boats ("keels") carried from fifteen to thirty tons. They were light in weight, of small draft, and were propelled by oars, sails, setting poles, cordelles, and by bushwhacking.[20] Bushwhacking, or pulling along by the bushes, was the method used when the boat ran close to the margin of the stream in high water. The "Kentucky flats," or "broadhorns," were arks from fifty to eighty feet long and fifteen feet wide, capable of carrying from twenty to forty tons. Many of them were protected from rain by slightly curved roofs. They were more unwieldy than the keels and could not be used in such shallow waters. Five men, on an average, were required to navigate one.

The barges were the largest of these boats and carried from fifty to a hundred tons. They were fitted with sails somewhat like those of a schooner. In ascending the Mississippi, when the wind did not serve, the unwieldy craft was warped upstream by means of two yawls. This required from thirty to thirty-five men, and only six to eight miles a day could be covered. The journey from New Orleans to Cincinnati, thus made, consumed from ninety to a hundred days.[21]

Navigation of the river was laborious and dangerous, but despite all difficulties traffic on it grew rapidly in the latter half of the eighteenth century and the first quarter of the nineteenth. Not till the Louisiana Purchase, however, was trading sufficiently safe to point its steady development.

Until about 1820 the trade of the lower Mississippi originated largely in the Ohio basin, inasmuch as settlement was most advanced in that region. Much flour was produced, for which the natural market was New Orleans. Louisville was the starting point for most of the boats, and the journey from that point to New Orleans required from thirty to thirty-five days. The surplus products of the settlements along the Monongahela, the Ohio, the Kentucky, and the Cumberland consisted of flour, pork, whiskey, apples, cider, lumber, horses, cattle, and lime. Of these, flour was by far the most important. In 1824 Ohio shipped 300,000 barrels of flour, amounting to one-fourth the value of all the products descending the Mississippi.[22]

The Missouri River valley contributed little other than peltries to the traffic of the Mississippi. The Indian trade of Upper Louisiana proved highly profitable; but south of the thirty-second parallel it served only to impoverish the valley and retard its development, for it diverted attention from agriculture, and the furs were of comparatively small value.

Spring and autumn were the busy seasons for the boatmen engaged in the trade on the Mississippi. Every considerable farmer in the "western country," or Upper Louisiana, built his boat each season to send his surplus to the New Orleans market. Only a few of these boats ever returned owing to the laborious nature of the upstream journey, in which human en-

[20] Timothy Flint, Recollections, etc., p. 91.

[21] *Idem*, The History and Geography of the Mississippi Valley, Vol. 1, pp. 151–152.

[22] F. H. Dixon: A Traffic History of the Mississippi River System, *Natl. Waterways Commission Doc. No. 11*, Washington, D. C., 1909, p. 17.

ergy was the power. Furthermore, the expense was a large item, the cost of cheap, heavy articles being doubled by the freight charges. Dry goods, hardware, and similar articles could be brought by wagon to Pittsburg from Baltimore and Philadelphia more cheaply than by water from New Orleans. In many cases the boatmen returned by land, leaving the Mississippi at Natchez and taking forty-five days for the 1,100-mile trip back to Lexington. So arduous was this that many of the boatmen returned by sea from New Orleans to Philadelphia or New York.[23]

In the second decade of the nineteenth century the advent of the steamboat wrought a marvelous change in the life of the pioneers and in the character of the traffic on the Mississippi River. In 1817, 1,500 flatboats and 500 barges brought produce to New Orleans; by 1821, 287 barges came regularly to the city. The Faubourg St. Marie was the trade center. On account of slack water in front of its *batture* the flatboats moored there. Strife between Creoles and Americans gave rise to three municipalities, the old town of "Vieux Carré," the Faubourg St. Marie (a suburb), and the Faubourg Marigny (a suburb). The governments of each were distinct, but there was a Mayor and Council for the whole. | Vieux Carré was the Creole section, retaining control of the trade in coffee, indigo, sugar, rice, foreign fruits, and wines; while cotton, tobacco, pork, beef, corn, and northern British goods were received in the American section. In 1825 the commerce of New Orleans was worth $17,000,000. In 1835 it had trebled. By 1840 New Orleans was the fourth city in population in the United States.

The decades 1840–1860 were flourishing times for New Orleans. Very considerable drainage was effected by the New Basin and Melpomene Canals. A tide of European immigration was flowing in at the rate of 300,000 yearly, of which a large percentage was German. The first railroad of the region (1820–1830), and one of the earliest in the United States, connected New Orleans with Lake Pontchartrain;[24] and the New Orleans and Nashville and the Mexican Gulf came into existence in the later thirties. By 1860 two railroads joined New Orleans with the railroads of the Mississippi Valley and Texas. The first was to Jackson, Miss., and the second to Opelousas, La.

Receipts from the interior jumped from $45,700,000 in 1842 to $107,000,000 in 1851. New Orleans and the valley were humming with prosperity. The steamboat had done much to nullify the influence of geographic isolation. The course of progress in the valley seemed open to an almost unlimited development though, as transpired, other influences entered shortly that turned the stream of commerce away from New Orleans.

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[23] Michaux, p. 182.

[24] Henry Whittemore: Fulfilment of Three Remarkable Prophecies in the History of the Great Empire State Relating to the Development of Steamboat Navigation and Railroad Transportation 1808–1908, [Brooklyn? 1909?], Part II, pp. 23, 25.

THE DISMEMBERMENT OF HUNGARY

By B. C. Wallis

From the standpoint of nationality the old kingdom of Hungary was a Magyar nucleus within a group of "subject nations." The relations between the dominant and the subject nationalities formed the theme of a statistical analysis by the writer. The results which were published in the *Geographical Review* [1] may now be re-examined in respect to the changes arising from the dismemberment of Hungary.

The old state has been split into the new Hungary—roughly comprising the Magyar nucleus—and Fiume as sovereign states and into components of four encircling states, comprising in the main the subject nationalities. The German west has gone to Austria, the Slovakian and Ruthenian north to Czecho-Slovakia, the Rumanian east to Rumania, and the Slav south to Yugo-Slavia. Utilizing the census of 1910, and the boundaries of the new states with as much precision as is possible, Table I indicates the proportions of area and population between the distributed parts.

Table I—Shares, in Area and Population, of the Distributed Parts of the Former Kingdom of Hungary

States	Area		Population		Density per Square Mile
	Thousands of Square Miles	Percentage	Thousands	Percentage	
Hungary	36	28	7,540	36	209
(Budapest)	—	—	(880)	(4)	—
Austria	1.6	1	330	2	206
Czecho-Slovakia	24	19	3,560	17	148
Yugo-Slavia	25	20	4,200	20	168
Rumania	40	32	5,210	25	130
Fiume	—	—	50	—	—
Total	126.6		20,890		

The Rumanian section is the largest and the least densely peopled; the Austrian section, excepting Fiume, is the smallest and nearly the most densely peopled. The new Hungary is less than a third in area with more than a third of the population of the old kingdom. The two Slav sections,

[1] B. C. Wallis: The Rumanians in Hungary, *Geogr. Rev.*, Vol. 6, 1918, pp. 156–171; The Slavs of Northern Hungary, pp. 268–281; The Slavs of Southern Hungary, pp. 341–353; Central Hungary: Magyars and Germans, pp. 421–435. See also "The Peoples of Hungary: Their Work on the Land," *Geogr. Rev.*, Vol. 4, 1917, pp. 465–481.

in the north and the south, are almost equal in area; but the southern contains more people. The new boundaries are of considerable interest. They substitute arbitrary lines for natural features, except along the Danube below Pressburg and along the lower Drave. They cut across the natural districts; the little and great Alföld, the Banat, and the Bačka are not entirely within one new state; Rumania has received more than the Transylvanian plateau; Yugo-Slavia more than the mesopotamia of Croatia-Slavonia. Furthermore, they ignore the administrative lines which have been developed in the old Hungary; they rarely coincide with the old boundaries of counties or districts (*jarasi*); and they divide, sometimes, the territorial area in possession of the great Alföld towns.

It is extremely interesting to follow the sinuosities of the new limits in relation to the character of the inhabitants of the adjacent villages and small towns and to note how, at times, places with a German majority are given to Austria while neighboring Magyar villages remain to Hungary. In general, the lines, as will be seen later, lie within the boundary zones where the population is not entirely of one race. The principle of nationality, however, is not the sole factor determining the run of the lines, as is seen from the results shown in Table II.

TABLE II—POPULATION BY NATIONALITIES OF THE DISTRIBUTED PARTS OF THE FORMER KINGDOM OF HUNGARY

(*In thousands*)

STATE	TOTAL	MAGYAR	GERMAN	JEWISH	SLOVAKIAN	RUMANIAN	RUTHENIAN	YUGO-SLAV	OTHER
Hungary	7,540	6,250	480	460	180	50	—	50	70
(Budapest)	(880)	(583)	(48)	(204)	(20)	(3)	—	(7)	(15)
Austria	330	25	235	20	——	——	—	50	——
Czecho-Slovakia	3,560	955	120	270	1,720	10	430	5	50
Yugo-Slavia	4,200	560	460	40	60	70	10	2,850	150
Rumania	5,210	1,550	520	138	10	2,820	20	50	102
Fiume	50	5	2	2	——	——	—	15	26
Total	20,890	9,345	1,817	930	1,970	2,950	460	3,020	398

Until the boundaries shall have been finally laid down, and the new censuses taken, the figures of the 1910 census are the only safe guide. Consequently the estimates in Table II are only approximate; at the same time, as in the writer's previous papers, the census returns have been recast in order that the Jews might be estimated as a race. On this basis the new Hungary contains but two-thirds of the Magyars. It is probable, however, that the numbers of Magyars in the other states will show some relative decrease, since the Magyar officials and their families will not find further

employment among the late "subject races;" but the Szeklers of Transylvania and the Magyars north of the Danube in Czecho-Slovakia will, many of them, remain outside Hungary. The Magyars form four-fifths of the population of the new Hungary, the largest minorities being Germans and Jews. There is no reason to suppose that the Germans who live in the ethnic islands near Lake Balaton and near Budapest or that the Jews who are mainly urban people will forsake the new state. The new Hungary remains the most densely peopled area in the old Hungary; and the large population of Budapest and the comparatively populous towns Szeged, Debreczen, Miskolcz, Kecskemét, Hódmezö-Vásárhely give a proportional excess of town dwellers.

In the Czecho-Slovakian section half the people are Slovaks, and one-eighth are Ruthenes. The minorities are large, especially in the case of the Magyars. The Jews are scattered over the east where they will probably remain. This section is likely to lose population on the whole, since the Magyars will tend to decline in numbers and there is no very great reason to suppose that the Slovak and Ruthene will cease to migrate or emigrate. It may be argued that the Slovak, once free from Magyar despotism, will become more stay-at-home; but the new state is pledged to an uplifting educational and social policy, which will tend to unsettle the next generation of these Slavs. The dour existence among the Carpathians will not attract in face of the easier life of the plains; the Slovak may migrate to Moravia or Bohemia instead of to the Alföld; but he will, almost certainly, move away from the hills. The Yugo-Slavs number less than three-quarters of the people in the Yugo-Slavian section. The Magyar minority will decline, the Germans of the Bačka and Banat will remain, and the other minorities are comparatively trifling. The new boundaries have untied politically some 95 per cent of the Yugo-Slavs of the old Hungary; so that, unless Yugo-Slavs migrate from Serbia and Bosnia to the more fertile lands beyond the Save, the population of this section will remain little altered.

Nearly all the Rumanians of the old Hungary are now Rumanian citizens; but at the same time the new conditions give to the enlarged Rumanian state considerable Magyar and German minorities, relatively great numbers of "foreigners." These people will almost certainly remain in their villages and townships.

In Fiume the Italians form the most numerous section of the population, which will probably remain with little proportional change.

A detailed examination of the new boundaries in relation to a nationalities map of Hungary reveals some interesting facts. The results as regards the Magyars are of the greatest importance. On the west, between the Drave and the Danube, the boundary gives Hungary some Germans and Croats but does not give to Austria any Magyars. By contrast, on the east, between the Tisa and the Maros, the boundary almost entirely cuts across territory where the people are above 95 per cent Magyar; e.g. Szatmár-Németi, Nagy-Károly, Nagy-Várad are definitely Magyar towns. The new Rumanian

territory includes not only the highlands of the Bihar massif but an area sufficiently far into the Alföld to include the towns and villages which control the valleys leading down to the north and the west of the massif—a strip whose inhabitants are Magyar. South of Szeged the Magyars have lost a Magyar area including Zenta, Topolya, and Péterréve which is included in Yugo-Slavia; but elsewhere on the south Hungary includes the Magyar population. In the north there is a great contrast. Almost from Pressburg (Bratislava) eastwards to the Ipoly the area for 20 miles north of the Danube is Magyar; the linguistic boundary lies north of parallel 48° N. The remainder of the northern boundary from the Ipoly across the Sajó, Hernád, and Ung valleys to the northeast corner lies well within Magyar territory.

The common boundary between Rumania and Czecho-Slovakia is, on the whole, just to both nationalities; on the balance, too, the boundary of Rumania with Yugo-Slavia gives to each nationality its own villages, with perhaps a larger share of the German areas to Rumania. The latter state has been well served by the boundary makers. Practically the whole of the definitely Yugo-Slav territory is included within the new state, which has a distinct gain in the possession of Szabadka (Subotica).

It may be a matter of poetic justice that the Magyars, who treated the idea of national rights (other than their own) with contumely, should have suffered most now that boundaries are made on nationalistic lines.

From the point of view of religious adherence, the new Hungary differs from the old kingdom. With the exception of the Protestants, mainly Calvinists, east of the Tisa, the bulk of the people are Roman Catholics. The Austria and Czecho-Slovakia sections are Roman Catholic.. Rumania contains nearly all the Greek Orthodox of the old state; the rest are in Yugo-Slavia. There are Lutherans in Rumania; but half the area is Roman Catholic, as is more than half of Yugo-Slavia.

From the standpoint of communications two facts are important. Yugo-Slavia controls the lower Danube navigation; it definitely holds both banks of the Danube and also the junctions of the Drave, Save, and Tisa with the main stream. On the other hand, Hungary retains the greater portion of the railways; no part of the boundary is much more than 150 miles by rail from the capital; most of the main lines and nearly all the cross connections are within the new Hungary.

HUMAN GEOGRAPHY OF FRANCE: A REVIEW*

As Vidal de la Blache's well-known "Tableau de la géographie de la France" formed the introduction to Lavisse's great co-operative history of France, the work under review will constitute, when completed, the introduction to a new co-operative "Histoire de la Nation Française" now appearing under the editorial direction of Gabriel Hanotaux. This first volume of the "Géographie humaine de la France" is a large, imposing, clearly printed tome, full of diagrammatic maps and tasteful sketches in black and white and in color. Written in a free, discursive style, it fulfills—so far as it alone is concerned—the promise of Hanotaux in his introductory remarks to the series as a whole, that a departure was to be made from Germanic methods which encumber the reader with the mechanism of scholarship and overwhelm him with "the details of research and the chicanery of discussion." The reader is to be served only with the matured results of long, deliberate, and careful study of authorities in their respective fields. This is certainly true of Brunhes' book; it is a work characteristic of French scholarship. Couched in popular form, readable and inspiring to the novice in the subject, it is at the same time a profound and original contribution to scientific literature.

Americans have for some time been familiar with the "Human Geography" of Jean Brunhes; as its subtitle reads in the English translation, "an attempt at a positive classification; principles and examples." The new work is the logical application to a specified territory of the broad principles outlined in the "Human Geography," for the latter certainly made no claim to be more than an outline of method and was in no sense intended to pose as a complete manual of a vast subject. In both books we cannot fail to be struck by the author's broad scholarship, his command of the literature of geology, history, anthropology, and geography, his able mustering of a mass of detail, and, at the same time, his originality of thought and vivid picturesqueness of style. If now and then we are a little stupefied by his Gallic flights of rhetoric, we are delighted on nearly every page by the incisive turns of phrase expressing complex and difficult ideas, the neatness of which has justified us, we hope, in giving way in this review to a frequent temptation to quote.

Gabriel Hanotaux says that the historical point of view changes from generation to generation and that each successive generation must write its own history of France. This is also true of the geography of France (or of any other dynamic country, for that matter). To be convinced of this, let us but compare the learned compilations of facts given in the books of Malte-

* Jean Brunhes: Géographie humaine de la France. Vol. 1 (forming, with "Introduction Générale" (LXXX pp.), Tome 1 of Gabriel Hanotaux, edit.: Histoire de la Nation Française, 15 vols.). 495 pp.; maps, ills. Société de l' Histoire Nationale, Plon-Nourrit & Cie., Paris, 1920.

Brun and Elysée Reclus with the analytical volumes of Vidal de la Blache and Brunhes. But Brunhes does not reduplicate the work of his teacher, Vidal de la Blache, the great apostle of regional geography, the founder and inspirer of a new and vital French school. The pupil to a large extent abandons the strictly regional method, partly on principle, as we shall see, and partly because in doing so he is given a free field for the synthesis of many observations and ideas which a strict adherence to regional description would have made difficult, if not impossible.

The "Géographie humaine de la France" is divided into six parts of which only the first two fall into the present volume. The first part is entitled "General geography, the permanent framework and the human factor." By "permanent framework" is meant the geologic and physiographic structure of the country (*l'architecture du pays*), its climate, and its river courses, which may rightly be regarded as permanent and unchanging so far as man is concerned. But, while Brunhes devotes separate chapters to developing the subject of man's natural environment, he constantly keeps this environment in view when interpreting the facts of human geography. He remarks humorously: "Geology and morphological topography are not *hors d'œuvres* which geographers must treat in one or two chapters as a sop to their consciences." Though he stresses the idea that human geography is never static, but constantly changing, he considers that the type of people composing the French nation, as well as certain human institutions, have acquired a sort of relative permanency. Hence he includes also in the first part of his book chapters on the origins of the French population, and on place names, languages, and dialects.

The second part, entitled "First principles of regional geography," is a study of the various natural, human, and administrative regions into which France has been, is, and might be divided; of provinces and *pays*, regions characterized by divers forms of habitation, by various groupings of habitations in relation to each other; and (in the Epilogue) of ideal political and economic regions.

Political and economic geography in their wider scope, social and economic life, and demography are subjects reserved for the second volume.

Throughout the book Brunhes sounds a note of warning against all seductively simple explanations and deductions. An apparently obvious relationship will not seem so obvious, an a broad generalization will not seem so safe, when the facts are examined in detail and critically weighed. Many years ago Dufrenoy and Élie de Beaumont explained, in terms which have become almost classic in French geography, a supposed antithesis between the Massif Central and the Paris Basin. The Cantal, placed in the center of the Massif Central, they styled the *pole of repulsion* of France, away from which the rivers of nature and the streams of human life alike took their course as if repelled by the convex slope and general inhospitality of the ground. Paris, on the other hand, in the concave hollow of the Paris Basin, they termed the *pole of attraction*, the center of population and of

civilization towards which all things converge. In criticizing this pretty idea and other generalizations of the same ind, Brunhes makes a remark which we may well regard as the text of his entire work: "Truth," he says, "is more delicate than this, more subtly nouanced. Geology and physical geography certainly aid in explaining human geography and history, but they do not fatally determine them. One is almost tempted to recall an expression of Pascal and to say that the two latter sciences belong to a wholly different 'order' from the former."

In much the same spirit Brunhes attacks the "simplifiers" among the historians, who have conceived of the history of France as conditioned by a gigantic and continuous struggle between opposing races. "Human facts are more complicated than an oversimple archeology and history have often depicted them for us." He criticizes attempts made in the past to mark off by a sharp line on the map the boundary between the territories of the *langue d'oc* and the *langue d'œil* and explains how recent studies have shown that "the reality is much too complex to be expressed by a simple line of separation." A map is supplied to illustrate how in reality one dialect merges into the other.

The same underlying motive—which, perhaps, marks a reaction against that sometimes exaggerated love of logical classification and arrangement so characteristic of the French—led Brunhes to turn his back on the regional method of treatment. For many years after the middle of the eighteenth century French geographical thought was held captive by the theory that the hydrographic basins of rivers form veritable geographic units. Though this might be true in some cases, it was finally perceived that many river systems are entirely lacking in geographic homogeneity, as is notably the case with the Loire and the Rhine. Geographers then came to regard countries "as being constituted of divers *regions* which they wished violently to cut off one from the other." The importance of natural regions was, in Brunhes' opinion, exaggerated; and too much of the idea of watertight compartments entered into geographic description. In his own work he takes a middle course between those who overemphasized the importance of river systems and those who overemphasized the importance of regions.

The rivers serve him as convenient connecting threads (*fils conducteurs*) for a preliminary and relatively brief regional description of the whole of France, introductory to the comparative studies that form the main part of the book.

Theorists, Brunhes complains, have been prone to urge a radical administrative reorganization of the nation into "regions" of their own devising. He was, however, ready to admit that the organization by *départements* leaves much to be desired and, in the Epilogue to the volume before us, suggests a governing principle that should be kept in view in any future subdivision of France. The great mistake in the past has been the advocacy of administrative regions of homogeneous character. "The region of the future ought not to be specialized in the narrow sense of the word but should be founded

on an adaptation to natural and human conditions which will—if we may be permitted a technical term of modern industrial economy—orient it towards *integration.*" Diversity, rather than uniformity, will in the long run produce the greatest richness of provincial life both spiritual and material.

Brunhes' main contribution to human geography has been the study of the tangible and material modifications which man has made of the earth's surface by building houses, farms, roads, villages, cities. The study of the human habitation as a geographic element is being pursued more vigorously in France than elsewhere, probably on account of the great variety of habitation types that exist in that country. We may, perhaps, take exception to Brunhes' remark that of all the "essential facts by which man's activity is written upon the earth's skin" (*faits essentiels par lesquels l'activité des hommes s'inscrit sur l'epiderme terrestre*) the house is the most geographic and most characteristic. Certainly the same general type of habitation—house and barn—is found throughout the farming districts of the northern United States under widely varying conditions of physiographic environment and ethnic tradition. In Europe, on the other hand, with its infinite variety in the forms of habitation, Brunhes' words hold good. One may fall into the pitfall of over-easy generalization in dealing with habitations: one is often tempted to jump at the conclusion that the form of house, arrangement of stables, granges, outlying buildings, etc. are inevitably a direct result of the type of agriculture carried on and that this in its turn is the immediate result of the nature of the ground and of the climate. This is undeniably true in some parts of France: in Rouergue, for instance, there are three kinds of soil, three types of agriculture, and three types of habitation—all corresponding very neatly to one another. On the other hand, Brunhes shows us that in Flanders a sharp boundary line between two areas of different types of habitation is determined not at all by physiographic, but by ethnographic, differences on either side of the line. There are two distinct forms of roof construction in France, steep roofs and flat roofs: the steep roofs have been said to be characteristic of the rainy climate of the north; the flat roofs of the dry climate of the south. Brunhes has tested the application of this statement by drawing a map of the roof forms throughout the country. This shows that, whereas in a very general way flat roofs prevail in the south and are characteristic of Mediterranean conditions, and steep roofs prevail in the north, there are many exceptions to the rule. Large areas in the southern Massif Central have steep roofs, and there is a great island of flat-roof country between Châlons-sur-Marne and Épinal. The details of this distribution, he concludes, have been determined entirely by historical causes and do not in any way reflect local climatic or physiographic conditions.

THE FIFTH JOINT MEETING OF THE AMERICAN GEOGRAPHICAL SOCIETY AND THE ASSOCIATION OF AMERICAN GEOGRAPHERS

The fifth joint meeting of the Association of American Geographers and the American Geographical Society was held at the Society's house, Broadway at 156th Street, New York, on April 22 and 23. Mr. John Greenough, President of the Society, welcomed the members of the Association, and Miss Ellen Churchill Semple, President of the Association, presided. The program follows:

Friday Morning Session

WILLIAM L. WESTERMANN: The Treaty of Sèvres.

NEVIN M. FENNEMAN: Certain Human and Economic Problems Growing Out of Physical Conditions in Africa.

HOMER L. SHANTZ: New Vegetation and Land Classification Maps of Africa.

CURTIS F. MARBUT: A Proposed Soil Map of Africa.

Friday Afternoon Session

ALAN G. OGILVIE: Distribution Studies in Relation to the Millionth Map of Hispanic America.

GEORGE M. MCBRIDE: Geographical Aspects of Land Tenure Systems in Mexico.

M. AUROUSSEAU: The Distribution of Population—A Constructive Problem.

Friday Evening

Round Table Discussion of GEOGRAPHICAL RESEARCH led by

F. E. ST. AUSTELL, Continental and Commercial National Bank, Chicago.

H. P. VOSE, Research Department, American International Corporation, New York City.

ARCHER W. DOUGLAS, Simmons Hardware Company, St. Louis.

H. H. BARROWS, University of Chicago.

Saturday Morning Session

HENRY S. GRAVES: Our Critical Forest Problems.

FRANK A. WAUGH: Diversity of Forest Utility.

The Society entertained the Association at dinner on Thursday and Friday night and at luncheon on Friday and Saturday. On Thursday night following the dinner there was an informal conference on "Geography in Higher Institutions of Learning," led by Professor Edward B. Mathews, Chairman of the Division of Geology and Geography, National Research Council.

Under the title of "Geology and Geography in the United States" Professor Mathews' paper (with Homer P. Little as junior author) is published in a preliminary edition in the Bulletin of the Geological Society of America, Vol. 32, 1921, pp. 1–22, Reprint and Circular Series of the National Research Council. It is a paper of more than passing importance in the development of the educational side of these two subjects. In a summary of the paper are the five following conclusions of geographical interest:

"The opportunities for training in geography are inadequate to supply the specialists demanded. In our educational system there is also an unfortunate break in continuity of instruction in the subject in high schools and colleges, so that few become acquainted with its possibilities as a vocation.

"The present lack of collegiate instruction prevents the presentation of the professional possibilities of geography and deprives students of a general training especially helpful in many fields of activity.

"The productivity of the relatively few specialists in geography is great, covering a wide range of subjects, without very clear definition of the limits of geography toward other subjects, either as to method or matter.

"Closer characterization in this respect would help administrative educators to understand the advantages accruing from the establishment of courses in collegiate and university geography and their proper departmental association.

"Research in geography is largely unorganized and individual, except in the field of exploratory expeditions."

Both the program and the discussions were even more interesting and valuable than on preceding occasions. Of the papers mentioned in the program, that by Mr. Aurousseau will be published in the October number of the *Review;* those by Messrs. Marbut and Shantz will form part of a descriptive pamphlet to be published with maps of the soils and vegetation of Africa under the joint auspices of the National Research Council and the American Geographical Society; Mr. McBride's paper will form a number in the Research Series of the Society; and Mr. Ogilvie's paper dealt with matters relating to the millionth maps and accompanying handbooks announced in an earlier number of the *Review.*

Professor Westermann's spirited paper dealt with the historical setting of the treaty of Sèvres; Dr. Graves' paper presented the state of forests and forest problems in their geographical relationships; and Mr. Waugh's paper gave a general view of the character, use, and value of the forest reserves of the United States.

GEOGRAPHICAL RECORD

AMERICAN GEOGRAPHICAL SOCIETY

Presentation of the Cullum Geographical Medal to His Serene Highness Albert I, Prince of Monaco. At the monthly meeting of the American Geographical Society on April 23, 1921, at the Engineering Societies' Building, 29 West Thirty-ninth Street, the Cullum Medal of the Society was presented to His Serene Highness Albert I, Prince of Monaco. In presenting the medal, President Greenough, who presided at the meeting, spoke as follows:

"The present occasion is in some respects unique in the long history of the Society. Our royal guest has divested himself, for the time being, of his prerogative as Sovereign, and desires to be met here solely on the universal platform of scientific research and attainment. Therefore, in awarding him the medal, which as your President, I am about to present, the short inscription upon it was framed in simple phrase as follows:

TO ALBERT I, PRINCE OF MONACO
1921

By intensive exploration and by research and publications of the highest order he has advanced the science of oceanography and extended man's knowledge of the sea and its resources.

"It is difficult to summarize briefly the methods and results which have distinguished the labors of our guest during a period now exceeding a quarter of a century. In every department of oceanography he has been the leading exponent, and he has provided an establishment for the preservation and continuance of his life work by the building in Paris and Monaco of two beautiful structures to serve as a museum for his collections, and as a laboratory for his permanent staff. This Oceanographic Institution, as it is named, has been adequately endowed by him, and under his supervision directs the forces in vessels, equipment, plans, and personnel requisite for his investigations.

"His yacht, *The Princess Alice*, has periodically traversed the ocean, mapping the configuration of its floor, measuring its currents, and revealing the mysteries of the life and condition of its denizens, employing in all these researches many new and ingenious instruments and devices. Likewise, valuable meteorological studies have been conducted of great interest and practical value to navigators.

"It is not possible at this time to enumerate all his varied contributions to scientific learning, which embrace not only the surface of the waters, but likewise, the elements above and below them. Suffice it to say that the institution which he has founded stands the chief of its kind in the world.

"And now, Sir, on behalf of the American Geographical Society, I beg that you will receive this memorial of its appreciation of your long continued service to the science to which we are mutually devoted. It will be a lasting source of pride to the Society that our insignia have been accepted by one who has contributed so notably, alike by his own achievements, by the distinction of his personality, and by the incentive of his example."

After receiving the medal and expressing his appreciation of it His Highness outlined the beginnings of his work in oceanography and the development of his great oceanographic museum. His talk was illustrated with still and moving pictures representing almost all phases of the actual field work necessary to gather the types on exhibition at the museum. On the geographical side there was discussed both the methods and the results of soundings of the sea and the air. An informal reception followed the lecture.

Elections to Fellowship. At the April meeting of the Society, President Greenough presiding, there were presented with the approval of the Council the names of 266 candidates who were duly elected as Fellows of the Society.

Presentation of the Livingstone Medal to William Speirs Bruce. The presentation of the Livingstone Medal to William Speirs Bruce took place at the monthly meeting of

the Royal Geographical Society in London on December 20, 1920, the occasion being felicitiously chosen to precede a discussion on the "*Future of Polar Exploration.*"

Introducing Ambassador John William Davis, by whom the presentation was made, President Lieutenant-Colonel Sir Francis Younghusband said:

"The American Geographical Society of New York have awarded their Livingstone Medal to Dr. Bruce, the great Antarctic explorer. Dr. Bruce unfortunately is not able to be present here this evening on account of ill health, but Dr. Rudmose Brown is here to receive the medal on his behalf, and His Excellency, the American Ambassador, has honored us with his presence this evening; he will, on behalf of the American Geographical Society of New York, present the medal to Dr. Rudmose Brown. At a meeting when we are going to discuss both the past and the future Polar exploration we thought it a specially favorable opportunity for this ceremony. I will now ask His Excellency to present the medal."

In presenting the medal Ambassador Davis said:

"I have in my possession, as the President has told you, the David Livingstone Centenary Medal which was founded by the Hispanic Society of New York on the occasion of the one-hundredth anniversary of the birth of David Livingstone and is to be awarded by the American Geographical Society, for whom I speak, for scientific achievement in the field of geography in the southern hemisphere. It is my very great pleasure, on behalf of the American Geographical Society of New York, to deliver that medal tonight to the representative of the distinguished scientist and explorer whom they have chosen as its recipient. To this gathering, of course, I need say nothing in vindication of their selection, nor can I fail to express my own gratification that no narrow confines have limited their search for a person worthy to receive the medal and that they have found such a recipient in the British Isles. To give even a catalogue of all Dr. Bruce's achievements in the field of geographic exploration would be beyond either my powers or your patience, but since the medal is directed solely to exploration in the southern hemisphere, it is well to recount that in 1892–1893 Dr. Bruce was the naturalist of the Scottish Antarctic expedition, in 1896–1897 he was the leader of the Jackson-Harmsworth Polar expedition, in 1902–1904 he was the leader of the Scottish National Antarctic expedition. He was the discoverer of the 150 miles of the coast line of the Antarctic, named by him Coats Land, and has bathymetrically surveyed great areas of the South Atlantic Ocean and the Weddell Sea. He was for many years the Director of the Scottish Oceanographical Laboratory of Edinburgh, is an LL.D. of Aberdeen University, and a Fellow of the Royal Society of Edinburgh, and I feel for myself that it is not only a pleasure but an honor to deliver this tribute to so distinguished a scientist from his brothers in science across the sea."

The Ambassador thereupon presented the medal, in the acceptance of which on behalf of Dr. Bruce, Dr. Rudmose Brown spoke as follows:

"Your Excellency, I am asked by Dr. Bruce to thank the American Geographical Society for the high honor that it has conferred upon him, and you personally, Sir, for your kindness in coming here to deliver the medal. Dr. Bruce wishes me to assure you that he considers it a very high honor indeed that his work should be recognized by the countrymen of such great explorers as Wilkes, De Long, Greely, Peary, and others. I will convey this medal to Dr. Bruce, and your kind words, Sir, in presenting it."

Mr. Joerg's Mission. Mr. W. L. G. Joerg, Editor of the Research Series of the Society, sailed from New York on May 21 for a six months' journey in western and central Europe. He will investigate the status and tendencies of geographical work in learned societies and in universities and colleges; and in addition he expects to attend the meeting of the geographical section of the British Association for the Advancement of Science at Edinburgh from September 7 to 14, and to be the Society's representative at the centennial celebration of the Geographical Society of Paris from July 4 to 7. Communications to him may be addressed in care of Brown, Shipley & Company, 123 Pall Mall, London, S. W.

NORTH AMERICA

Great Cities of the United States, 1920. The 1920 census of the United States shows 64 cities with a population over 100,000. This includes single cities and group cities. The group cities (starred * in Table I and listed by components in Table II) are those that

make up one city mass of continuous extent, without regard to political control, even though it cross state boundaries (as at New York), international boundaries (as at Detroit), or deep water (as in both those cases), for deep water, when well supplied either with ferries or bridges, connects its shores in a most intimate way.

TABLE I—POPULATION OF CITIES OF OVER 100,000 PERSONS

1	New York*	6,657,447	34	Birmingham, Ala.	178,806
2	Chicago	2,701,705	35	Syracuse, N. Y.	171,717
3	Philadelphia*	1,952,250	36	Richmond, Va.	171,667
4	Detroit *	1,118,137	37	Norfolk, Va.*	170,164
5	Boston*	1,071,897	38	New Haven, Conn.	162,537
6	St. Louis, Mo.*	839,664	39	Memphis, Tenn.	162,351
7	Cleveland, O.	796,841	40	San Antonio, Tex.	161,379
8	Baltimore, Md.	733,826	41	Dallas, Tex.	158,976
9	Pittsburgh, Pa.*	681,412	42	Dayton, O.	152,559
10	Los Angeles, Cal.	576,673	43	Bridgeport, Conn.	143,555
11	Buffalo, N. Y.*	524,693	44	Duluth, Wis.*	138,588
12	Cincinnati, O.*	512,651	45	Houston, Tex.	138,276
13	San Francisco, Cal.	506,676	46	Hartford, Conn.	138,036
14	Milwaukee, Wis.	457,147	47	Scranton, Pa.	137,783
15	Washington, D. C.	437,571	48	Grand Rapids, Mich.	137,634
16	Kansas City, Kan. Mo.*	425,587	49	Paterson, N. J.	135,875
17	New Orleans, La.	387,219	50	Youngstown, O.	132,358
18	Minneapolis, Minn.	380,582	51	Springfield, Mass.	129,614
19	Oakland, Cal.*	317,946	52	Des Moines, Ia.	126,468
20	Seattle, Wash.	315,312	53	New Bedford, Mass.	121,217
21	Indianapolis, Ind.	314,194	54	Fall River, Mass.	120,485
22	Rochester, N. Y.	295,750	55	Trenton, N. J.	119,289
23	Portland, Ore.	258,288	56	Nashville, Tenn.	118,342
24	Denver, Colo.	256,491	57	Salt Lake City, Utah	118,110
25	Louisville, Ky.*	244,989	58	Albany, N. Y.	113,344
26	Toledo, O.	243,164	59	Lowell, Mass.	112,759
27	Providence, R. I.	237,595	60	Wilmington, Del.	110,168
28	Columbus, O.	237,031	61	Reading, Pa.	107,784
29	St. Paul, Minn.	234,698	62	Fort Worth, Tex.	106,482
30	Omaha, Neb.*	227,763	63	Spokane, Wash.	104,437
31	Akron, O.	208,435	64	Yonkers, N. Y.	100,176
32	Atlanta, Ga.	200,616		Lynn, Mass.	99,148
33	Worcester, Mass.	179,754		Tacoma, Wash.	96,965

The group cities are realities, but the census recognizes them only when they have been politically united, as Brooklyn and New York have been since 1898. Brooklyn was geographically a part of New York long before the city governments were "consolidated;" and Jersey City is today a part of New York—a fact more difficult to confirm politically.

The criterion used in selecting the adjacent towns to be included with a city is continuity of close, city-like occupation of the ground on land areas, which includes park spaces, properly a part of a city to maintain the health of its citizens, but does not include farm lands and meadows that may be included within the political city area, as in Queens Borough, New York. The group city so conceived is a more real city than the Metropolitan Districts of the Census Bureau, which include all population centers of 5,000 people within 10 miles of the city limits. No one who looks over the actual ground between New York and Paterson, whether he travels by train or road, can say that Paterson, N. J., is part of one continuous city with New York. There are doubtless many ties between the two towns that a little inquiry would bring out, but their separateness leaps to the eye. This is not equally true of Newark, for there is nothing between it and New York but water channels and marshes that may conceivably be dredged out or built up to form an expansion of the actual port of New York. Navigable water at a great seaport ties opposite shores most intimately. The proper selection of adjacent places to be included calls for local

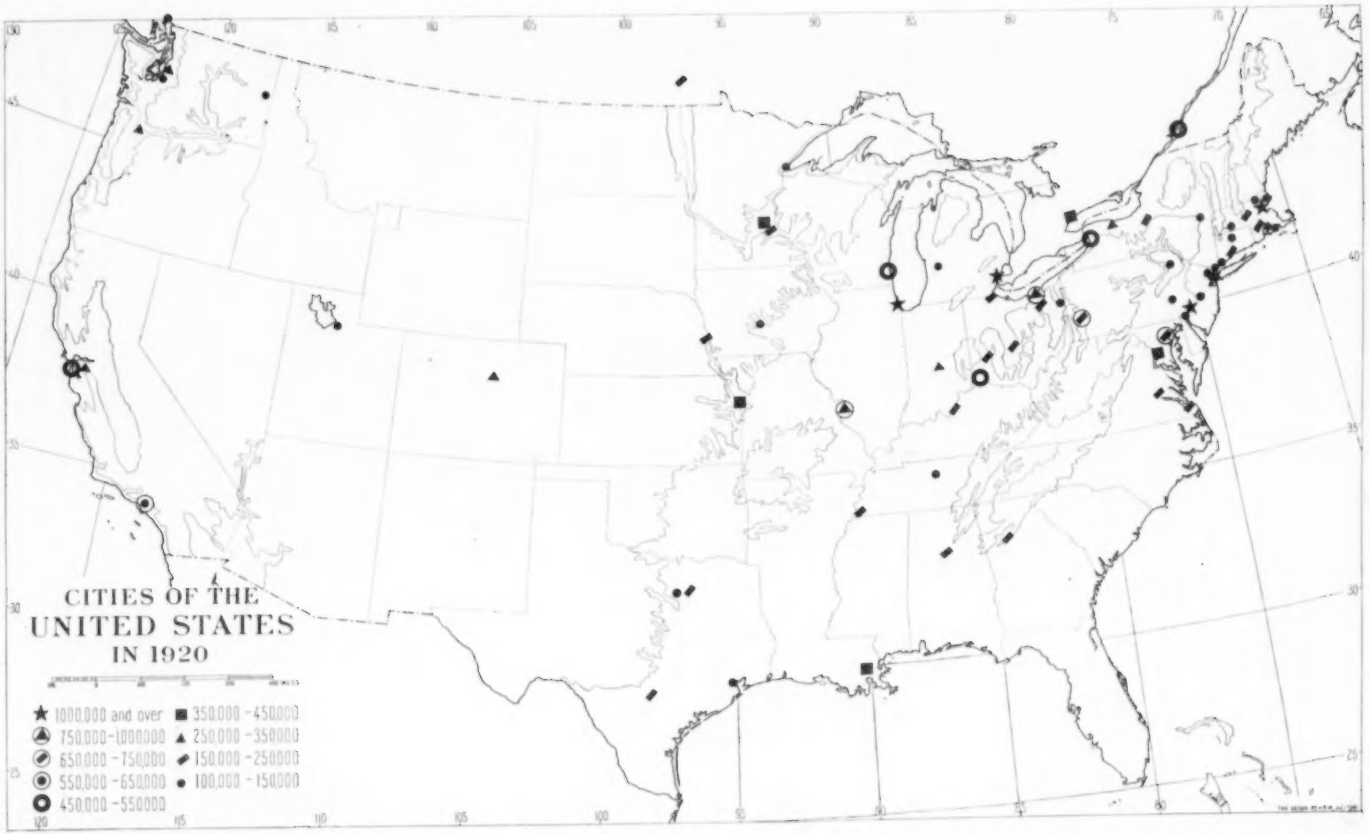

FIG. 1—Great cities of the United States (100,000 population and over) according to the 1920 census. Canadian cities have been added according to the 1911 census. Note distribution in regard to elevation as shown by the addition of the 1,000-foot contour line.

knowledge. Probably other places than those listed as group cities should be so regarded. The compiler of this list would be glad to have information on this head. Should St. Paul and Minneapolis be regarded as one?

TABLE II—COMPONENTS OF GROUP CITIES LISTED IN TABLE I

1	New York	5,620,048	11	Buffalo	506,775
	Newark, N. J.	414,524		Lackawanna	17,918
	Jersey City, N. J.	298,103			524,693
	Elizabeth, N. J.	95,783			
	Bayonne, N. J.	76,754	12	Cincinnati, O.	401,247
	Hoboken, N. J.	68,166		Covington, Ky.	57,121
	West Hoboken, N. J.	40,074		Newport, Ky.	29,317
	North Bergen, N. J.	23,344		Norwood, O.	24,966
	Union, N. J.	20,651			512,651
		6,657,447	16	Kansas City, Mo.	324,410
3	Philadelphia, Pa.	1,823,779		Kansas City, Kan.	101,177
	Camden, N. J.	116,309			425,587
	Gloucester City, N. J.	12,162	19	Oakland, Cal.	216,261
		1,952,250		Berkeley	56,036
4	Detroit, Mich.	993,678		Alameda	28,806
	Hamtramck	48,615		Richmond	16,843
	Highland Park	46,499			317,946
	Windsor, Ont. (estimate)	29,345	25	Louisville, Ky.	234,891
		1,118,137		Jeffersonville, Ind.	10,098
5	Boston, Mass.	748,060			244,989
	Cambridge	109,694	30	Omaha, Neb.	191,601
	Somerville	93,091		Council Bluffs, Ia.	36,162
	Chelsea	43,184			227,763
	Everett	40,120	37	Norfolk, Va.	115,777
	Brookline	37,748		Portsmouth	54,387
		1,071,897			170,164
6	St. Louis, Mo.	772,897	43	Duluth, Minn.	98,917
	East St. Louis, Ill.	66,767		Superior, Wis.	39,671
		839,664			138,588
9	Pittsburgh, Pa.	588,343			
	Wilkinsburg	24,403			
	Homestead	20,452			
	McKees Rocks	16,713			
	Sharpsburg	8,921			
	Bellevue	8,198			
	Millvale	8,031			
	Edgewood	3,181			
	Aspinwall	3,170			
		681,412			

On the map have been added the only great cities of Canada according to the census of 1911—Montreal 470,480, Toronto 376,538, Winnipeg 136,035, Vancouver 100,401 (estimates for 1919 give: Montreal 670,000, Toronto 489,681, Winnipeg 183,595, Hamilton, Ont. 110,137, Quebec 110,000, Vancouver 109,250, Ottawa 104,000). The 1,000-foot

contour line is also added. It shows strikingly how the cities are distributed over the lower lands and the passages afforded by river valleys. Of course effective communication in these days is always by rail beside the river.

MARK JEFFERSON

The Topographical Map of the United States. The mapping of our country may be said to have been in progress since the time Captain John Smith made a chart of Chesapeake Bay, but after three hundred years only forty per cent of our area has been topographically mapped and of this forty per cent a large part needed to be re-surveyed because of the improvement in methods and the greater accuracy demanded by the map users. It is safe to say that only between twenty-five and thirty per cent of the area of the United States has been adequately surveyed and mapped topographically.

Yet in various scientific, industrial and commercial undertakings the topographical map is a fundamental. No one would expect to have accurate geological surveys made in an area over which topographical surveyors have not previously operated; nor would one expect an engineer to construct a dam for the storage of water for either irrigation or power development without a topographical survey of the drainage basin. The highway engineers of the country need topographical maps in order to lay out their system of principal roads with a view of getting the most feasible route between centers of population and to provide low grades along the road. The forester needs to know the configuration of the forest area in the proper utilization of forest products. The stockman desires to know the slope of the ground in planning grazing operations. The prospective farmers need to know the configuration of the territory within which they expect to settle. Cases are known to the writer where farms have been selected without a visit from the purchaser when he had a topographical map covering the area and a report of the Bureau of Soils. Not the least of the uses of a topographical map are connected with defense. Its significance in military operations has been amply shown by the experience of the armies in Europe during the Great War.

The United States has vast natural resources in the form of minerals, including coal and iron, water power, lands that may be irrigated and drained, forest productions, etc., but we do not know just what we have in the way of resources nor do we know whether in all cases we can utilize those whose existence is known. In order to discover what we have and to utilize and conserve our resources we need the topographical map as a basis of our information and activities.

A special interest therefore is attached to the bill introduced in the House of Representatives on April 26, 1921, by Congressman Temple of Pennsylvania, providing for the completion of the topographical survey of the United States.

The bill if passed will authorize the president to complete, within a period of twenty years from the date of the passage of the act, a general utility topographical survey of the territory of the United States, including adequate horizontal and vertical control. The bill also provides for the preparation and publication of the resulting maps and data. The president would be authorized to utilize the services of such agency or agencies of the government as now exist or may hereafter be created and to allot funds to them from the appropriations made from time to time to carry out the purposes of the act. The bill also provides that co-operative agreements may be made between the agencies of the government carrying on the topographical surveying with any state or subdivision thereof. It is hoped that early hearings will be held by a Committee of Congress on this most important measure.

WILLIAM BOWIE

SOUTH AMERICA

General Rondon's Work in the Brazilian Wilderness. The April number of *France-Amérique* contains an appreciation by General Gamelin of General Rondon's work (Le Général Rondon et ses explorations au Brésil, pp. 81–87).

From his own country where his exploits have surrounded him with a halo as that of the legendary hero General Rondon's fame has traveled afield. Fellows of the American Geographical Society will recall the review of his achievements made by Colonel Roosevelt on the occasion of the presentation to General (then Colonel) Rondon of the David Livingstone Medal of the Society (*Geogr. Rev.*, Vol. 5, 1918, pp. 496–497). A native of Cuyabá, capital of Matto Grosso, Rondon has spent some thirty years of his life in the *sertão* of this

vast state. His explorations, made in the service of the Brazilian Telegraphic Commission, have covered a block of territory lying between the parallels 3° and 22° S. latitude and the meridians 50° and 65° W. of Greenwich. This great region is not infrequently known as Rondonia following the term of Professor Róquette-Pinto in his anthropological-ethnological study "Rondonia" (*Archivos do Museu Nacional do Rio de Janeiro*, Vol. 20, 1917).

The most concrete result of Rondon's work is the telegraphic link between the waters of the Paraguay and the Amazon across the heart of the continent. It comprehends 4,500 kilometers of line, to which correspond paths 5 to 10 meters broad cut in part through tropical forest and in places paralleled by roads practicable for automobiles, and dotted by nuclei of native populations where nomadic savages are being initiated into ways of settled life. The work has been carried out in a series of stages. The years from 1890 to 1898 were spent in construction of the line from Goyaz to Cuyabá whereby this erstwhile isolated town was brought into touch with the rest of the country. From 1900 to 1904 the line was extended to Corumbá, the port of Cuyabá on the Paraguay. Here with the success that has peculiarly stamped his dealings with primitive peoples Rondon pressed into his service members of the intractable Bororo tribes. From 1905 to 1906 lines were laid in the south of the state along the Bolivian and Paraguayan frontiers. In 1907 Rondon embarked on the most important stage of his work as regards geographical results—that in the northwest for the installation of the line to Santo Antonio de Madeira. From this date to 1915 with his assistants he carried out the series of explorations of the Amazonian tributaries that take their source in the Matto Grosso uplands. It was on one of these that he was accompanied by Colonel Roosevelt in the journey that changed the "Rio de Duvida" to "Rio Theodoro" (Colonel Roosevelt's Exploration of a Tributary of the Madeira, *Bull. Amer. Geogr. Soc.*, Vol. 46, 1914, pp. 512–519). Here may be noted the recent decision of the Geographical Society of Rio de Janeiro to change the river name to "Rio Roosevelt." From 1915 to 1919 Rondon remained in Upper Matto Grosso and Amazonia completing his geographical work the results of which appear in the series of publications by the Commissão de Linhas Telegraphicas Estrategicas de Matto-Grosso ao Amazonas.

EUROPE

Upper Silesia: An Essay in Geographical Description. Under the title "Oberschlesien" Professor Bruno Dietrich of Breslau makes a contribution to a forthcoming volume of geographical sketches by pupils of Professor Hettner of Heidelberg (Zwölf länderkundliche Aufsätze von Schülern Alfred Hettner's ihrem Lehrer zum 60. Geburtstag, Breslau, 1921, pp. 63–80).

Upper Silesia, the terminal part of a political peninsula of Prussia projecting southeastward up the Oder drainage area between what used to be Austria and Russia but is now Czecho-Slovakia and Poland, is of special interest today on account of the political situation.

Dietrich's description of the natural subdivisions is informing but somewhat difficult to understand because of the repeated use of unimportant town names. The accompanying outline map is too crude to lessen this defect to any extent. In this note Dietrich's provincial method is replaced by a self-explanatory form of statement whose intelligibility may be tested by the reader's success in drawing or imagining an outline map as the successive specifications are followed.

The province of Upper Silesia is a quadrilateral of irregularly sinuous boundary, measuring 100 kilometers on the southwestern side, 120 kilometers on the northwestern, 140 kilometers on the northeastern, and 80 on the southern. It is for the most part underlain by horizontal indurated strata, much dislocated by block faulting; but the initially uneven surface thus produced is almost extinguished by post-faulting degradation, by a partial unconformable cover of less indurated strata, and by widespread unconsolidated deposits of glacial drift and loess. The resulting upland surface, from 200 to 300 meters in altitude, is for the most part of low relief, being a small section of the great plain of central Europe. The areas of sandy drift are generally wooded; the loess-covered areas are farmed. The upland is traversed a little west of its center by a 100-kilometer stretch of the moderately sinuous Oder valley, trending north-northwest, 6 kilometers wide at its upstream (southeastern) entrance and 12 kilometers wide at its downstream exit, with the towns of Ratibor near its upper end, Cosel above its middle, and the important city of Oppeln near its lower end. The province is thus divided into a smaller southwestern isosceles triangle and a larger northeastern rectangle, both of indented sides. The smaller or triangular area is truncated at

its end, where it is 12 kilometers wide upstream; it widens to 60 kilometers at its downstream end and rises gradually to the foothills of the Sudeten on its southwestern side, near the middle of which a small salient of Czecho-Slovakia penetrates the triangle for 20 kilometers. This area is mostly agricultural, with Neisse in the northwest and Neustadt and Leobschütz on either side of the Bohemian salient as its chief towns; but a 40-kilometer segment of its northern angle is largely woodland, with Falkenberg near its center.

The larger rectangular area northeast of the Oder valley is 140 kilometers in length on its strongly indented northeastern side and 50 or 60 kilometers in width. A rich, loess-covered farming district 10 or 20 kilometers wide, of somewhat hilly surface, crosses its southern end where the ascent to the Beskiden ridges of the Carpathians begins; there Rybnik to the west and Pless to the east are the chief towns, and a long segment of the northern angle is occupied by a less fertile farming district which stretches 90 kilometers from the middle of its northeastern to the middle of its northwestern side; here Kreuzburg to the northwest, Rosenberg near the middle, and Lublinitz to the southeast are the chief towns. The rest and greatest part of the rectangle is chiefly woodland without large towns; but there are two important districts of other character. One of these is a higher upland belt, known as the Chelm, determined by an uplifted block of horizontal limestones, which modestly surmounts the rest of the region. It has a width of 10 to 20 kilometers and a length of 80 kilometers, trending east and west and therefore running obliquely across the middle of the rectangle from the Oder valley between Oppeln and Cosel nearly to the eastern border of the province and thus separating the great woodland area into a northern and a southern part. Forests prevail along the northern side of the belt where sandy drift is largely present; cultivated areas are found along the southern side where loess is abundant. The limestones of the Chelm contain ores of iron, zinc, and lead, as is further noted below; the ores are mined mostly near the eastern end of the belt, where Tarnowitz is the chief town.

Much more important than any other is a semicircular district next south of the Chelm, with its limiting diameter of 40 kilometers on the eastern border of the province; in this half circle—part of a larger area that continues east and south into Poland—deformed and degraded coal-bearing rocks reach the surface and determine a remarkable concentration of industries. Here are the richest coal reserves in Europe, and here mining, smelting, and manufacturing flourish, especially in the Prussian part of the coal-bearing area; for, although the international boundary cuts the coal field about in half, nearly 71 per cent of its product in 1911, or about 40,000,000 tons, came from Prussian mines, and this constituted 23 per cent of the coal mined in all Germany. Zinc and lead ores from the Chelm limestones are smelted here and supply 63 per cent and 20 per cent of the German product of these metals. Iron production is also important, although it is small compared with that of the Rhine province; but, as fuel for smelting is abundant, iron ore from the Chelm is largely supplemented by imported ore.

With the development of the mineral resources of this district, cattle and wood, which were the chief products of the province in earlier centuries, now have a relatively low rank; primitive iron smelting with charcoal, which used to be carried on in the woodland district north of the Chelm, is abandoned; and the small semicircular industrial district, formerly not populated more densely than the rest of the province, now has about 700,000 inhabitants, or a third of the total. Some of the industrial centers increased three or four fold in the 40 years following 1871. A network of railroads now connects many towns of large size, the chief being Königshütte, Beuthen, Gleiwitz, Zaborze, and Kattowitz; the landscape is characterized by shaft houses and furnace chimneys; the use of timber in the mines is causing serious encroachments upon the neighboring woodlands. Little wonder that the threatened loss of a province which includes so rich a district as this is dreaded by Germany; while the gain of the province by Poland would make a magnificent addition to her already great economic resources.

Dietrich's final remarks on the population of Upper Silesia are of interest, though their interpretation is open to question. As a borderland not defined by physiographic barriers, the people have been of mixed origin for centuries past. Since the time of Frederick the Great, when Silesia was Prussia's share of booty in the partition of Poland, Upper Silesia has been the southeastern outpost of Hohenzollern conquest and domination. In 1910 the German-speaking population was 884,000, and the Polish, 1,169,000; with less than 10 per cent of the total speaking other languages. But, of the Polish-speaking majority, Dietrich claims that many speak "Wasserpolnisch" and that these are really Germans who have acquired a local dialect of the prevalent language; also that even the Upper Silesian

Polish-speaking inhabitants consider themselves Silesians, and not Poles living in Silesia; and that the present movement in favor of junction with Poland does not represent the wishes of these inhabitants but results from a propaganda conducted from beyond the boundary.

On the other hand, a less prejudiced view may be found in the chapter on Poland by the junior author of Haskins and Lord's recent book, "Some Problems of the Peace Conference" (Cambridge, Mass., 1920). After asking: "Since the rise of Prussia was accomplished mainly by the spoliation of Poland, could any one hope to effect a genuine restoration of Poland without taking a great deal of land away from Prussia?" Lord adds that the Prussian official language statistics in Silesia and other provinces formerly Polish "have been demonstrated by the most painstaking and detailed investigations" to be "grossly inaccurate" and "in fact deliberately falsified for the purpose of making it appear that Prussia's Germanizing policy in her 'Eastern Marches' has been more successful than is actually the case." This is partly proved by the Prussian school census of former Polish territory, which shows Poles to be from 50 to 100 per cent more numerous than they are represented in the general census.

The abundance of mineral deposits in the semicircular district of southeastern Upper Silesia, unknown at the time of the partition of Poland, and the resulting great development of industries through the nineteenth century have greatly increased the intensity of feeling with regard to the possible readjustment of international boundaries. Thus the truly geographical factor of natural resources has a dominant share in determining economic and historical problems.

W. M. Davis

The Cartographical History of Lower Austria. The *Monatsblatt des Vereines für Landeskunde von Niederösterreich* issues its July-September number of 1918 as a testimonial to Dr. Oswald Redlich on his sixtieth birthday. Herein appears an article by Dr. Eugen Oberhummer on "Die Entstehung des Kartenbildes von Niederösterreich," brief but pointed, and written in the scholarly and scientific vein so characteristic of all that has appeared from the pen of that distinguished Austrian geographer.

The first attempts to give place on the map to the region of Lower Austria, it is noted, had an early date. One could not expect to find it laid down on the small world maps of the Greeks, such as were those of Anaximander or of Eratosthenes; but in the monumental portico map of Agrippa, one time minister of Augustus, we find a work overtopping any corresponding previous effort, and in this the provinces of Rhaetia, Noricum, and Pannonia appeared. How he had represented the Danube region we may judge from such maps as the Peutingerian table and the Ptolemy maps drawn a century and a half later, in which there does not appear to have been great improvement.

Dr. Oberhummer, in agreement with that greatest living authority on the geography of Ptolemy, Professor Joseph Fischer, believing that we have in the recently found Codex Vaticanus Urbinus 82 the real or excellent copies of the first Ptolemy maps, notes that this manuscript contains a map of the Danube region.

One would scarcely expect to find on the cloister maps of the middle ages any attempt at an accurate representation of Lower Austria, or of any other region; and yet on the Ebstorf map of the late thirteenth century we find the Danube with certain tributaries represented and the names Wena, Austria, Crenesa, Starkenberch, and others—the first time the names Vienna and Austria appear on a map.

The accuracy of coast representations as we find them on portolan charts is properly noted, as is also the fact that there followed soon after their appearance the attempt to give a corresponding accuracy to the representation of interior regions. The author refers to the improvement in this respect to be observed in the charts of Angelino Dalorto of 1325 and 1329 and in the Catalan map of 1375.

In the map of middle Europe by Nicolaus Cusanus of 1450, but known in later editions only, and in the map of Germany as given in the Nuremberg Chronicle we find the Danube region coming more and more into prominence. We further note, about this time, a sort of attempt to combine the Roman road-map idea and the ordinary land map, an example of which we have in the "Carta itineraria Europae" of Waldseemüller.

Special independent maps of individual regions came into existence in Germany in the sixteenth century, the first of them being the Johannes Stabius map of the crownlands of Austria as they were in 1508, while in the year 1545 appeared Wolfgang Lazius' map of

Neiderösterreich, that is the entire Grand Duchy of Austria. His was the pattern map for all those issued of the region until the appearance of the Matthias Vischer map of 1670.

The author makes mention of the remarkably fine military map of the Hapsburg Empire begun by the order of Maria Theresa, but not completed before 1783, and now belonging to the department of the royal military archives. He concludes with a reference to the special map of Austria prepared between the years 1873 and 1880, and to the "administrative" map of Lower Austria, the issue of which was undertaken by the Verein für Landeskunde but awaits completion.

E. L. STEVENSON

AFRICA

Kufra: A Prosperous Desert Settlement in Northern Africa. The eleven oases of Kufra, described by Ettore Ceriani in *L'Africa Italiana* (Vol. 39, 1920, No. 3), constitute one of the still imperfectly known human settlements of the Libyan interior.

Since the journey of Gerhard Rohlfs in 1879 only three Europeans have visited Kufra. Involuntary journeys were made by an Italian soldier who was held captive from 1914 to 1917 and by a French officer who a year later was detained in Kufra for some months (*L'Afrique Française, Renseign. Colon*, April, 1920, pp. 82–88). A few months ago a remarkably successful journey was accomplished by an Englishwoman, Mrs. Rosita Forbes whose route was from Benghazi to Kufra and via Siwa to Alexandria (*Nature*, May 19, 1921, pp. 366-367).

Kufra has changed from the rude village described by Rohlfs to the proportions of a fairly organized small town. Its inhabitants, numbering some 10,000 according to estimates, are drawn from various sections of Mohammedan Africa and betray by their racial diversity the importance of the site as a commercial and religious center. The site is favored by an ample underground water supply which holds the first place among its natural advantages. Its climate, characterized by infrequent rainfalls and a subtropical average range of temperature, is not subject to such excessive changes of temperature as occur in other North African localities.

The modern prosperity of Kufra dates from the time of its selection as headquarters of the famous Senussi order. A fertile soil and the importance of the site at the junction of caravan routes connecting the Mediterranean coast with the sparsely populated hinterlands of northern Africa determined the choice. A feature of interest which characterizes the social organization of the Kufra community is found in the system of highly divided land tenure which prevails in the area. The relative importance of Kufra over other oases of the desert lands of northern Africa is thereby explained. It is a factor which, coupled to a relatively fertile soil, has made for the prosperity of the settlements. Practically every resident operates a farm, however small. Ownership of the soil is vested in the Senussi fraternity in the majority of instances, land being rented in small lots so as to satisfy the entire community.

Caravan traffic likewise brought its contribution to the prosperity of the settlement. An idea of the importance of this traffic may be gathered from the fact that for the second half of 1919 the value of goods passing through Kufra and routed to Cyrenaica alone amounted to over 2,000,000 lire. The traffic, however, was larger in former days, when caravans consisting of hundreds of men and camels would halt for several days at Kufra, there to renew supplies and to refit themselves for the remainder of the journey. In recent years, however, the caravan transit has been directed to Egypt, owing to the proximity of the oases within Egyptian boundaries. This innovation has led to an import trade by way of Egyptian caravan roads, which to the Italian colonial authorities appears as undesirable competition to the routing of goods via Libyan ports and roads. It appears that not infrequently Italian goods reach Kufra by way of Alexandria.

From the shores of the Mediterranean three main routes, starting respectively from Jedabia, Siwa, and Dakhla lead to Kufra. From Jedabia the journey lasts about seventeen days, travel consuming a daily average of twelve hours and being mostly accomplished at night. Over these roads caravans plow their way laboriously through a desert of deep sands and dunes. Twice only during the journey is water encountered.

In addition to the Mediterranean roads there are caravan routes linking Kufra with the Sudan, Wadai, and Tibesti. Over all these roads a constant, one might almost say daily, traffic reaches the great Senussi center.

LEON DOMINIAN

ASIA

Medieval Origins of the Armenian Question. The first number of the new *Revue des Études Arméniennes* (Vol. 1, 1920, Paris) contains a scholarly study by J. Laurent (Professor at the University of Nancy) on "The Medieval Origins of the Armenian Question." M. Laurent first defines the term "Armenia." It has been applied to widely separated territories. "Great Armenia" has almost universally been used from classical times to designate the rough, mountainous tract between the headwaters of the Euphrates and the Araxes. This is a geographical expression. On the other hand the region called "Little Armenia," a political expression, has moved about in the course of history. In Greek and Roman times it embraced the upper valleys of the Lycus, Halys, and Euphrates; but during the middle ages it was shifted south to the shores of the Mediterranean.

Whatever her situation as a political entity, Armenia has always formed a disputed frontier zone between relatively powerful and jealous neighbors: Persians, Byzantine Greeks, Arabs, Seljuk and Ottoman Turks, and Russians. This explains in part why the Armenians have never set up a solid, lasting state and why their history right up to the present has been so tragic. Furthermore, the Armenians have never been able to settle their internal troubles. They are quarrelsome people among themselves, and the constant state of civil strife in which they have lived has been fostered and made the most of by their neighbors. Nevertheless, though torn by almost continous struggles among her feudal lords (at one time there were no less than six rival "kings"), Armenia in the Middle Ages long managed to maintain a precarious and turbulent existence as an independent nation in the face of extraordinarily adverse circumstances both external and internal. The frontiers were continuously changing, and the entire state moved from a ninth-century home in the vicinity of Lakes Van and Sevan through various intermediate locations to the plains of Cilicia, where the Kingdom of Little Armenia, founded in the twelfth century, long lingered on as an outpost of civilization against the rising tide of Turkish conquest which was finally to overwhelm it.

Today Armenians are found not only in the regions now and formerly called "Armenia" but also in Constantinople as well as in large colonies throughout Anatolia. This is to a large extent the result of events that took place in the Middle Ages. Love of adventure, aggravated by abuses at home and the injustice of a feudalism which, if not actually depriving them of a share in their deceased father's property, subjected younger sons to the tyrannous feudal overlordship of their elder brothers, led to a continuous emigration of soldier-adventurers from among the nobles as well as of men of more humble estate. The lands and cities of the Byzantine Empire were the goal of most of these emigrants, who formed the nuclei of large Armenian colonies destined to preserve their own speech, customs, and traditions down to the present time.

AUSTRALASIA AND OCEANIA

Nauru: A Treasure Island of the Pacific. Situated in the central Pacific, 33 miles south of the equator and a few degrees west of the Gilbert Islands, is Nauru Island, famous for its vast deposits of the invaluable fertilizer, phosphate of lime. The island is 12 miles in circumference, 5,000 acres in extent. It has wide, flat foreshores, with a group of picturesque hills in the center, the location of the phosphate rock. Running completely round the island is a well-made, well-kept road sheltered by an avenue of coconut palms over eighty years of age. Though so near the equator the climate is comparatively cool and notably salubrious.

The Nauruans are a handsome, intelligent race. They are divided into two classes, the wealthy and ruling class, and the people, called "slaves of gratitude" from the fact they are maintained, that is fed and clothed, by the rich classes who control them. At the same time there is nothing of slavery in this control, and the people are happy and contented. They are loyal to their king, Oweida by name, and the ruling chiefs under him, and caste is strictly recognized. The people are quite free from all brutal tribal customs and obey but one law, that of the British administration. They are all quite civilized, many of them earning good wages working in the phosphate industry.

The sea around the island abounds with a great variety of fish, and the natives go out in the roughest weather in their frail canoes, returning in a few hours with large quantities of fish. These are not killed and eaten but are carefully conveyed alive to beautiful lagoons, or small lakes, in the hills. Every village owns a lagoon, and every villager a portion of

the water, which he fences off with palm leaves. The fish are put into these "paddocks" of water; and the housewife, whenever she requires fish for her household, goes off to the lagoon and with her hands catches all she wants. One Nauruan dance is a drama representing a fishing expedition, wherein the dancers have live fish tied to their heads, chests, arms, and legs. The weird effect can be imagined: as the dancers move the fish wriggle, their silvery scales against the black skins sparkling brightly in the glare of great palm-leaf fires.

The national sport of Nauru is the maintaining and capturing of hundreds of frigate birds, solemn-looking creatures of no use and not ornamental. In the season when these birds are plentiful gala days are arranged when owners of birds assemble at a rendezvous on the beach. Great roosts like skeleton roofs of houses are carried in procession from the villages, and these are covered with birds securely tethered, among them being some decoy birds. The decoys are uncanny creatures that display an intelligence almost human in the way they do their work. The decoys are let loose and instantly soar aloft to attract wild birds. These, at first unseen, presently come wheeling overhead in great numbers, are enticed to the roosts, and are promptly caught and tethered by young natives hidden below. At nightfall a count is made of the captures of the day, and the native king in an elaborate address proclaims the village that is the winner. During the rest of the night there is feasting and dancing; at daybreak the roosts are taken up, and all return to their villages.

Forty years ago the Germans took possession of this tiny island valued then but as a link in the chain of territories which the German Imperial Government hoped would surround the Pacific and give Germany mastery of the southern hemisphere. Before the war, while the full value of Nauru had been recognized by the Germans as a source of phosphate (huge royalties were derived from the exploitation, which was in the hands of a British company), they nevertheless considered the island still more valuable as a strategic naval station. On it was installed the most powerful wireless station of pre-war days—a station which played a very active part in the first weeks of the war as far as the Pacific was concerned. The general neglect, however, of so useful an island was hardly in accordance with German policy in the South Pacific, for on all other German islands the government and settlers did much to promote development and commerce, achieving therein signal success.

Since 1914 British administration has been in force. The administration promptly took an interest in the natives, especially in improving and making profitable the native coconut plantations and in the attention paid to health. A fine native hospital has been built and is excellently managed by an American doctor who has done wonders in coping with native diseases.

Meanwhile the rich phosphate deposits have made Nauru a "Treasure Island" in the eyes of many nations. Japan (who has secured the phosphate-producing island of Angaur in the Pelew Islands) claimed it as part of the German territory of the Marshalls, though it is south of the line. Australia and New Zealand both put in strong claims. The mandate, however, has been given to the British government. An agreement made subsequently divides the phosphate: the United Kingdom and Australia each receive 42 per cent of the output, New Zealand the remaining 16 per cent. It has been estimated both by British and German experts that there are at least 40,000,000 tons of phosphate rock on the surface of the hills, which can be mined and collected with little effort. The industry, which has been in the hands of a British enterprise known as the Pacific Phosphate Company, will be placed under the management of a commission whose officers are to be appointed by the English, Australian, and New Zealand governments. It is expected that the working staff, one with years of experience, will be continued and that the industry will be carried on without interruption.

The phosphate industry is justly accounted a notable enterprise. When it is borne in mind that Nauru is in one of the most remote parts of the world and that it costs much time and money to get there and back, nothing but praise can be given to the plucky British company that set up its machinery there and has for twenty years been supplying the agricultural world with one of the most necessary of soil constituents. The Nauru industry has all the accessories of a great modern enterprise—cantilever jetties, railways, steam and electric power, electric light, telephones, fresh and salt water-supply systems, and splendid sewerage. Welfare and living conditions of all employees are among the best regulated in the world. Chinese coolies, with Caroline, Marshall, and Nauru natives, under a competent staff of white people number in all upwards of a thousand people. The scene is always

busy, the activity the more surprising as one emerges from the solitude of the ocean. Over 100,000 tons of phosphate is exported annually, and in the future this output is to be doubled.

THOMAS J. MCMAHON

The Mystery of Easter Island. Easter Island has long attracted attention as presenting one of the most interesting problems of Pacific ethnology. Towards its solution the Scoresby Routledge Expedition, at work on the island from 1914 to 1915, made notable contribution. An outline of the results accomplished by the Expedition was given in the *Geographical Journal* (Vol. 49, 1917, pp. 321–349) and abstracted in the *Geographical Review* (Vol. 4, 1917, pp. 221–222). Since then the narrative of the expedition has appeared under the title "The Mystery of Easter Island" (London, 1919). This volume by Mrs. Routledge is finely illustrated and agreeably written. In addition to the stay on the island Mrs. Routledge describes the journey thither and back in the specially designed schooner yacht *Mana*. Going out the *Mana* proceeded via the Strait of Magellan, the Patagonian waterways, and Juan Fernandez. On the homeward course by the Panama Canal, Pitcairn Island and Tahiti were touched. Detailed scientific results will be published in a second volume.

More recently (1917) Easter Island was visited by Carl Skottsberg and members of his expedition engaged in a biological survey of Juan Fernandez (see the article "The Islands of Juan Fernandez," *Geogr. Rev.*, Vol. 5, 1918, pp. 362–383). Certain interesting features of the island are briefly recounted in "Notes on a Visit to Easter Island" (extract from "The Natural History of Juan Fernandez and Easter Island," edited by Carl Skottsberg, Vol. 1, Upsala, 1920). The visit was short, and the object was primarily biological; but the people and the culture inevitably claimed some attention, and approving comment is made on Mrs. Routledge's deductions concerning the origin of the Islanders and their mysterious handiwork. Legendary tradition indicates populating of the islands by two main migrations, the earlier Melanesian, the later Polynesian. Dr. Skottsberg considers that relations with the western Pacific are clearly demonstrated in the similarity of the peculiar bird cult with that of the Solomon Islands (where the frigate bird is worshipped).

As a source still incompletely investigated attention is called to a critical examination of the language especially to the names of cultivated plants. *Cumara* is cited as a case in point. The sweet potato is known under this name from New Zealand through Polynesia to Easter Island. The word is also said to occur in Quechua and by some writers has been advanced as a proof of relations between western South America and Polynesia in pre-Columbian times.

Regarding the Easter Island culture Dr. Skottsberg makes comment on the physical conditions of life on the island. "The great scarcity of water makes the high development of the ancient culture quite astonishing." There is no running water on the island; sources are limited for the most part to lakes in the craters. One "cannot fail to notice the absence of every trace of valley or ravine caused by the action of running water." The rainfall indeed is considerable; for 8 years an average of 48 inches is recorded; but the volcanic soil is extremely porous, and under the hot sun and strong winds evaporation is high. Contrast with the islands of Juan Fernandez, situated 7° farther south and highly dissected by erosion, is most marked. Vegetation on Easter Island is poor. Apparently the island was never wooded; today only a few stunted trees exist. The greater part of the surface is covered with grass.

Dr. Skottsberg's paper is accompanied with a map (1:200,000) based on that of the Chilean Hydrographic Office; elevations, however, being given according to his own observations, which differ considerably from those of the Chilean map.

Agricultural Climatology of Australia. What is the rainfall, its reliability, its seasonal distribution? Tell the Australian agricultural climatologist, and he will indicate what part of his continent is referred to and what its chief agricultural products are. This, in effect, is demonstrated in Dr. Griffith Taylor's article, "Agricultural Climatology of Australia" (*Quart. Journ. Royal Meteorol. Soc.*, No. 196, Vol. 46, 1920, pp. 331–356). The delimitation of rainfall regions by these criteria give us the agricultural regions. The four major ones are: "The summer rain region in the north, the winter rain region in the south, the uniform rain region in the east, and the arid rain region in the center and middle west."

The hot north, because of its dry season and practically unbearable heat for any white man not doing more than light work, *e.g.*, riding with cattle in the open, is used for nothing but a sprinkling of cattle (it appears to be too hot for sheep).

The arid region of a million square miles contains less than one per cent. of the cattle and sheep of Australia. Aside from fodder, water for live stock is the limiting element: and cattle fare better than sheep, for cattle can cover so much greater distances.

The narrow, winter rain region in the south, with its subtropical location and reliable though moderate winter rainfall, supports chiefly wheat, sheep, and vines.

The uniform rain region in the east is the portion of Australia where the great majority of the people live and raise their crops and live stock. In the tropical section, Queensland and northeastern New South Wales, the summer maximum of rainfall and its quantity favor such crops as sugar cane on the coast and maize where the rainfall is less. There is plenty of timber in the rain forest, and in the drier interior cattle and sheep raising and some irrigation farming are carried on. Farther south, in southeastern New South Wales, Victoria, and the extreme southern part of Western Australia is the principal wheat and general farming and fruit-raising region. From the drier to the wetter parts, wheat, hay (largely grain cut green), oats, barley, and various fruits, grapes, oranges, peaches, apples, and pears are raised, and dairying is carried on. There is also an appreciable lumber industry. The winter maximum of rainfall and the dry summers are particularly favorable to wheat raising. Tasmania is wetter and cooler, its climate and products being very much like those of western Washington. Timber, oats, and dairy products are characteristic.

The agricultural future of the arid heart of Australia is not bright. Although there are more than two million square miles (more than two-thirds of the entire continent) which cannot be adequately developed without extra water, the irrigated areas in 1915 amounted to only a thousand square miles. However, the eastern mountains are well watered, and there are large artesian basins (under about two-thirds of a million square miles in the east-central part) which may be tapped for irrigation water; and big reclamation projects are under way. One alone is expected to provide ultimately 6,000 farms and a livelihood for 100,000 people. Drought is the ever-present menace of the principal cattle and wheat regions. Provision of better transportation facilities in these regions will allow the removal of live stock to better feeding grounds during droughts and thus prevent the heavy losses of the past.

CHARLES F. BROOKS

PHYSICAL GEOGRAPHY

Three Mountaineering Books; The Mt. Everest Expedition. Though most mountain climbing as an athletic sport contributes little or nothing to geographical knowledge, three recent mountaineering books and an ambitious plan for the ascent of the highest peak in the world are not without geographic interest.

In "Mountain Memories" Sir Martin Conway, former President of the British Alpine Club, looks back over a long and varied career of climbing in many ranges from Bolivian Andes to Karakoram, from Spitsbergen to Tierra del Fuego. The sporting and aesthetic aspects of mountaineering were always foremost in Sir Martin's spirit: he was Professor of Art at Cambridge, and the subtitle of his book is "A Pilgrimage of Romance;" but "Mountain Memories" also gives us a subjective insight into the evolution of a real and deep geographic enthusiasm. Sir Martin undoubtedly has that indefinable "geographic sense" which enables him to paint in vivid word pictures the appearance of mountain scenery in widely varied regions. Certainly books which make us "see" landscape fill an important place in geographical literature even though they make no pretense at being scientific.

"Mountain Craft," edited and to a large extent written by G. W. Young, and "Mountaineering Art," by Harold Raeburn, are handbooks for the climber and deal with matters of technique. They discuss in detail and with the discrimination of experts such practical questions as equipment, guides and guideless climbing, ice, snow, and rock work, mountaineering on skis, etc. Young is especially interested in the human and psychological aspects of mountaineering; his chapters on management and leadership contain many shrewd but sympathetic analyses of human emotions and impulses under conditions of fatigue, hardship, and danger. Though no man can learn from books either the art of leadership or the art of getting along with fellow travelers, Young furnishes many ideas that could be profitably considered by anyone planning to conduct geographical exploration whether on mountain snows or in warm lowlands. Both books deal with mountain reconnaissance and exploration. That skill in this branch of mountaineering art is of the utmost utility to geographer,

geologist, surveyor, and miner, whose business takes them into high ranges, will be recognized by all. Raeburn claims that some knowledge of geology is essential to the exploring mountaineer in order that he may tell "from a telephotograph, or a view through a glass at many miles' distance, the probable nature of the climbing on the peak he is aiming at" (p. 236). According to Young an adept in mountain reconnaissance can often judge whether he may expect to find rock, or ice, or névé on the opposite side of a range by the appearance of sky above the ridge crest. These are examples of some of the fine points of mountain reconnaissance. "Mountain Craft" concludes with a series of chapters by specialists giving valuable advice for would-be climbers in different parts of the world: the tropics, the Arctic, the Caucasus and Himalaya, Norway, New Zealand, the Pyrenees, Corsica and the Rocky mountains.

The Royal Geographical Society and the Alpine Club have this year organized a joint expedition for the ascent of Mt. Everest. Recent numbers of the *Geographical Journal* (January to May, 1921, inclusive) and the *Alpine Journal* (March, 1921) contain articles and notes on the geography of the Mt. Everest district, on Himalayan mountaineering in general, and on the plans for the expedition. Up to the present nobody has ever been within fifty miles of the highest mountain in the world. Telephotographic views of it from a distance give a most unsatisfactory idea of its topography because intervening ridges of immense height cut off from sight all but the very peak itself. Consequently a prime requisite will be the carrying out of a thorough survey of the mountain and its approaches. This will be the work of the season of 1921. It was planned for the party to leave Darjeeling in May and to work around to the north, or Tibetan, side of Everest by way of the Tang La Pass and Kampa Dzong to Tingri Dzong. As the bird flies an approach from the south would be more direct; but the southern side of the mountain lies in Nepal, a country closed to foreigners. Travel will also be easier to the north. The Tibetan slopes of the Himalaya as a whole have undergone less denudation and consequently are gentler than the Indian slopes; snow line is at a higher elevation (probably about 20,000 feet) owing to the fact that much of the moisture of the southwest monsoon is precipitated on its ascent of the windward slopes; yaks can in all probability be used as a means of transport through high, bare valleys and over arid ranges almost to snow line.

The preliminary reconnaissance of 1921 will certainly reap geographic results of great value; it goes without saying that much will be learned about Mt. Everest itself. In addition an immense unexplored tract to the north, northeast, and northwest will be revealed—a tract in which distant views have shown the presence of mountains of enormous height, rivaling, though probably not exceeding, that of Everest itself.

The attempt to reach the summit, scheduled for 1922, is to be led by Harold Raeburn, author of "Mountaineering Art." Mt. Everest rises over 4,500 feet above the highest recorded point to which man has climbed. The latest figure for the elevation of Mt. Everest is given by the *Geographical Journal* (January, 1921, p. 14) as 29,141 feet. The highest point reached by the Duke of the Abruzzi on Bride Peak, Karakoram, is 24,600 feet (the *Alpine Journal*, March, 1921, gives 24,583 feet). It is possible that at these immense altitudes wholly novel conditions of snow and ice may be found. The chances of success in the dash for the top will depend largely on atmospheric conditions; one thing in favor of the climbers is the fact that Everest lies relatively far back from the plains of India and is more or less masked by intervening heights from the clouds and snows brought by the monsoon. Probably the most interesting result of the expedition will be the new light that it will shed on human acclimatization to a combination of low air pressure with very low temperatures, for at the present time there is little uniformity either of opinion or of experience on this subject.

TERMINOLOGY AND ORTHOGRAPHY

The Spelling of Geographical Names. The origin and activities of the Permanent Committee on Geographical Names composed of representatives of interested departments of the British Government and of the Royal Geographical Society are described in brief by the chairman, Major General Gleichen in the January number of the *Geographical Journal*. The Committee had its inception, it is said, in the British Admiralty's dilemma over "what to call the place generally known as Walfisch Bay." A preliminary conference was held in April, 1919, and the Committee came into being the following month. The first concern of the Committee was to draw up a series of "Rules for the Spelling of Geographical Names for British Official Use" and a standard "Table of Spelling and Pronunciation." Both are

included in the above mentioned article. Together they are known as the R. G. S. II System and are based on an earlier system formulated by the Royal Geographical Society in 1865. Preparation involved such investigations as the scheme of Arabic transliteration described in the October, 1920, number of the *Geographical Journal* and the transcription of alphabets of some 32 languages which are to be published as No. 2 of the R. G. S. Technical Series. Work now being pursued with urgency includes the preparation of lists of place names in the territories of Britain's African mandates, Tanganyika Territory, Cameroons, and Togo, in order to settle spellings before they have time to "crystallize in wrong forms." Lists of the names are to be published from time to time as leaflets in the *Geographical Journal*. The first leaflet makes its appearance with the April number under the title "First General List of European Names." It may be obtained separately for the sum of sixpence from the Royal Geographical Society, Kensington Gore, London, S. W. 7.

GEOGRAPHICAL REVIEWS

A Geographical Study of the Peace Terms

M. I. Newbigin. **Aftermath: A Geographical Study of the Peace Terms.** 128 pp.; maps. W. & A. K. Johnston, Ltd., Edinburgh, 1920. $1.50. 7½ x 5 inches.

In the April number of the *Review* note was taken of Demangeon's striking essay "Le declin de l'Europe" (Paris, 1920). It was pointed out that certain natural remedial measures had been at work in the interval between the writing of the book and the publication of the review and that these, in part at least, diminished the force of the author's conclusions. We now have in Miss Newbigin's book a brief essay of similar character dealing with the territorial side of the matter. She attempts to give "an outline picture of the Europe which emerges from the various peace treaties, without assuming that 'Conference' Europe is likely to remain permanent." While criticizing some of the treaty decisions, the author has a lively appreciation of the peculiar problems that confronted the treaty makers, many of which were due to the state of mind in which they found the world in 1919. By far the best part of the book is the first chapter of fourteen pages, dealing with geographical principles and such questions as the rise of nationality, the relation of people to the land, the contrast between economic and nationalistic groupings, and, particularly, the contrast between the industrial life of western Europe and the primarily agricultural life of eastern and southeastern Europe. This general discussion ends with a point of great importance—that the conflicting forces of the Old World are still at work and that they will in the long run determine the political destiny of Europe and of the world, so little changed fundamentally by the war and the various peace treaties.

The chapters from 2 to 9, inclusive, take up the regional problems of large natural or political units, like eastern France and Belgium, Poland, Austria, Rumania, etc., and conclude with a brief note on Germany's oversea possessions. In this, the main part of the book, there is a small amount of philosophical writing, most of the material being descriptive and statistical. There are thrown into orderly form the main facts of territory, population, and boundaries, already widely known through the published peace treaties. The space allotted to the various topics is too small to permit the placing of the main facts in a proper historical and geographical setting, though the book has numerous suggestions of high value, reflecting the wide reading of the author.

Some of the statements that relate to the negotiations themselves are hardly reliable. It was never seriously proposed by the treaty-making powers to re-create Poland by simply annulling the partitions of a century and a half ago and throwing Poland's eastern boundary out into mid-Russia (p. 27). Nor was it a political action "based upon abstract principles" that was responsible for the establishment of the Free City of Danzig. It seems all the more strange that such a statement should be written by a British citizen. When the unanimous recommendations of the Polish Commission for the inclusion of Danzig in the Polish state were rejected by the Supreme Council it was on account of British opposition to that course rather than the application of the "abstract principles" of President Wilson. Whatever motive impelled the British leader to oppose some of his own advisers and insist upon the creation of a Free City, it can hardly be less than obvious that the creation of such a city is of great advantage to British trade. And when the author goes on to say that it is doubtful if the solution (Danzig a Free City) can be *permanent* unless the new world is very different from the old one, the reviewer would feel inclined to remark that the solution has at least a chance of being as permanent as the British Empire (p. 30).

The spirit of some of the statements seems curiously alien to common knowledge of some fairly well-known facts. It is leaning over backward to say that "there are signs at least that mineral oil is likely to increase rapidly in importance" (p. 13); and that the Upper Silesia plebiscite solution, as "a late addition to the Treaty," is a working hypothesis that "seems to account for some of its [the Treaty's] anomalies" (p. 32). Surely these things are matters of common knowledge. That river boundaries were selected along the western frontier of Poland is taken as evidence that the boundary makes no pretense to be a strategic one (p. 34), whereas the precise reason for selecting rivers was a strategic one. Even small

brooks may have a high strategic importance in the early stages of a campaign when by the use of machine guns a few men can hold large areas. While such streams can be crossed at any time that it suits the higher military command to cross them, there is always an added price which has to be paid for overcoming this or any other obstruction.

Like almost all others who have treated the subject, the author emphasizes the apparently impossible economic state into which some nations were thrown by the rearrangement of the boundary lines. She finds that the treaty makers "clung desperately to the 'principle of nationality' " (p. 88); that the western Rumanian boundary "cuts streams, canals, railways, and even minor ethnical groupings more or less at random" (p. 78). One has to face the fact that *any* solution of the problems of territory and nationality in Europe would be violently attacked by powerful groups. It would hardly have comported with the spirit of the times to have denied the rising states of central Europe the nationality for which they fought. Their aid seemed important if not vital at one time or another during the war; and to have retained the old boundaries would have been to reward them by turning them over to their historic masters. Hardly anyone would have accepted a possible third solution—the creation of economic groupings to be maintained by force under conditions that would have given superior power if not superior authority to the former ruling caste.

Pastoral Industry in the Economic Development of Spain

Julius Klein. **The Mesta: A Study in Spanish Economic History, 1273–1836.** xviii and 444 pp.; map, ills., bibliogr., glossary, index. (Harvard Economic Studies Vol. 21.) Harvard University Press, Cambridge, Mass., 1920. 9 x 6 inches.

Among the several fundamental Hispanic institutions which have been the subject of study during the last two decades none is of more interest from the viewpoint of geography than the one which forms the theme of this volume. The Mesta was an organization of the sheep owners in Spain, the chief function of which was the protection of their migratory flocks. The entire basis of the institution, as of the sheep migrations from which it sprang, was geographic. Neither Spain's extensive sheep raising nor this influential organization of the large-scale migratory pastoral industry would have existed except for the peculiar physical environment of the Iberian Peninsula.

Spain early became a pastoral country. The great semiarid, almost treeless *meseta* that occupies over one-half of the peninsula contains large areas that are suitable only for grazing (see Eduardo Reyes Prosper: Las estepas de España y su vegetación, Madrid, 1915). So little agriculture was possible in these regions that stock raising developed, not as an adjunct to husbandry, as in most other European countries, but as a separate occupation. Here, for centuries, have been raised the famous cattle of the Guadarrama hills and the merino sheep whose wool long supplied the choicest grades for European markets. During much of Spain's history the produce of her flocks has been her one important contribution to foreign trade.

Seasonal migration of flocks arises from various conditions. Sometimes, as in central Chile, the low pasture lands dry up in a rainless summer, forcing the herdsmen to move their flocks to moister mountain ranges. Again, as in Argentina on the opposite slope of the Andes, the herds are driven to the mountains during the season when rains prevail upon the plains, chiefly in order that the herds may escape the heat of the summer and the insect pests that accompany it, or that their principal feeding grounds may be allowed to recuperate. In Mediterranean countries migration is practiced chiefly in search of winter ranges when the mountains are inhospitable.

In Spain there are two great pasture zones. The first is the hill country, consisting chiefly of the Cantabrian-Pyrenees mountain system, of the Gredos, the Guadarrama, and the Ibérica ranges, and of the Serranía de Cuenca. The second zone includes some of the river valleys within the plateau, such as those of the Ebro, the Duero, and the Tagus, with upper sections of the Guadiana; extensive lowlands south of the plateau; and several districts within the southern half of the plateau itself, chiefly the steppes of La Mancha and Murcia. The sheep belong upon the highlands, where during the summer months they graze upon the hills. This is the dry season, but sufficient grass is found for their subsistence. In winter, snow covers up even this scanty pasture, and the bleak winds imperil flocks and shepherds alike. They are then forced to migrate to other regions. Sometimes pasture can be found in neighboring valleys, but usually journeys of several hundred miles are required before

they can reach districts where there is both a mild climate and sufficient grass. Fortunately while the plateau is receiving its winter snows (almost the only precipitation it enjoys) the southern plains are freshened by warm rains that make for the best of pasturage there. Some six months later the south becomes dry again, and the flocks must return to the highlands. Thus neither zone serves for perennial grazing, and the flocks must journey back and forth in search of feed (see André Fribourg: La transhumance en Espagne, *Ann. de Géogr.*, Vol. 19, 1910, pp. 231–244, with two maps).

It was under such conditions that the Mesta originated. In their journey across the central plains and through the southern borderlands in search of pasture these flocks were looked upon as intruders. Every town and peasant farmer, every feudal landlord resented the yearly eruption of these migrating herdsmen from the north, with their thousands of slowly moving sheep, for which they must find subsistence along the way. Taxes, tolls, and various assessments were invented to annoy the strangers and to enable the sedentary agriculturists of the south to reap some benefit in recompense for the damage wrought by these invaders. In order to resist the extortions practiced by local officials the herdsmen united and organized a system of common defense, with regulations that governed the migrations, a system of caring for the strays that frequently became separated from their flocks, and a corps of officers to protect their common interests. During several centuries this guild of sheepmen (supported by the crown, which saw in it a means of counteracting the *regionalismo* that has always afflicted Spain) dominated the pastoral industry of the country and exerted a strong influence upon the agrarian development, upon agricultural life, and upon the general economic condition of the nation. It is the internal organization of this powerful body, its external relationships, and its economic influence upon the country that are treated in the volume under consideration.

No thorough study of the Mesta had ever been made, and the work is based principally upon material found among the almost untouched archives of the Mesta itself. The four parts of the study treat respectively of the organization, the judiciary, taxation, and pasturage. Heavily documented, as such a study in an entirely new field must be, it at once becomes the standard work on the subject treated and leaves one less area unexplored in the field of Spanish institutional history.

Although it is frankly acknowledged by the author that geographical factors lay back of the practice of migrating, there is nowhere any satisfactory description either of the various grazing lands occupied by the flocks in different seasons or of the climatic conditions that made such migration necessary. The volume is concerned chiefly with the organization and the economic influence of the Mesta as an institution, yet some such account would seem essential as an explanation of the setting in which developed the migratory pastoral industry and which gave rise to the Mesta itself.

This volume on the Mesta brings out clearly the great need for further painstaking research into the underlying economic conditions in Hispanic culture. Two important matters, closely related to the present study and suggested in its pages, offer attractive fields for investigation—the land system of Spain, and the character, history, and place in the national life, of the Spanish town.

Geographical and Statistical Data on Hungary

Gustavus de Emich, Aladár de Edvi Illés, and Albert Halász, edits. **Magyarország Gazadasági Térképekben (The Economies of Hungary in Maps)**. 2nd edit. 74 maps, 6 diagrs. Budapest, 1920. 10¼ x 15 inches.

Critics of Hungarian official statistics find the figures of nationality so much distorted, to the advantage of course of the Magyars, that they are apt to convey to persons not conversant with the material an impression that the government statistics as a whole are uninforming and unreliable. Such an impression is mistaken. In statistics of social and economic interest the government provides accurate information more detailed than that which is available in most of the other countries of Europe. The present publication uses this information to picture the conditions of the country as they were about 1910. Most of the maps present as a base the Kingdom of Hungary within the frontiers as they were in 1914, but each map is accompanied by a transparent sheet on which are printed both the old frontiers and also the boundaries established for the new Hungarian state by the Treaty of Trianon, so that the student can readily estimate the significance of the territorial losses resulting from that treaty.

The atlas includes in all 74 maps and 6 diagrams. The subject covered most elaborately is Industry and Mining, with 29 maps. Next in importance come the subjects of Agriculture and Forestry, 18 maps; Population and Education (including prehistoric settlements, ethnography, literacy, emigration, land tenure, and publications), 8 maps; and Traffic, 7 maps and 4 diagrams. Of the remaining maps 3 are devoted to Energy (coal production, coal reserves, water power, and total energy developed), and the rest cover general and miscellaneous topics.

The section on Industry and Mining is unduly swollen by maps picturing the distribution of minor industries, such as those producing bricks, vegetable preserves, vegetable oil, soap, and candles. On the other hand it gives no map showing the distribution of industrial establishments according to size, although the statistics provide abundant means to illustrate this important aspect to modern industry. Maps showing the subsidies granted by the government to industry are of interest in that the government appears, contrary to what one would suppose, to have been most lavish in the outlying parts of the kingdom, notably in the Slovak districts of the north. In the section on Agriculture most of the crop maps picture area planted, not crop yields; but one map, showing the surplus or deficiency of cereals by counties, brings out clearly the interdependence of the different parts of the former kingdom in the production and consumption of these staples. Two maps in the section on Traffic are noteworthy, in that they distinguish the amount of freight and passenger traffic on the various lines of railroad; information of the kind provided by these maps is not easily procured, for either Austria or Hungary, and is of great value in framing a judgment of the economic relations of the country. Most of the maps are on the scale of 1:4,000,000. The ethnographic map by Professor Paul Teleki is on the scale of 1:1,000,000 and essays to show not only the linguistic distribution but also the density of population, by assigning a square millimeter of the appropriate color to each 100 inhabitants in a district. The map cannot be called a success, unless (as possibly was the case) it was designed to emphasize the ascendancy of the Magyars.

The maps in this atlas are more eloquent than printed pages in convincing the student of the grievous losses which Magyar Hungary brought upon itself in the war. The partition of the old kingdom cut to pieces an organic whole and entails an economic readjustment which will be a slow and most painful process. Magyar Hungary retains one valuable asset—the fertile plain which produces a handsome surplus of food. It fares well enough in the distribution of the current coal product. It loses the larger coal reserves and most of the other mineral resources of the kingdom. It loses the upper course of the rivers and much of the potential water power; it loses its timberland; it loses a great market for its industrial products. It has only the sorry consolation of knowing that, low as it has sunk, it still is better off than the new Austria.

CLIVE DAY

LOUIS LÓCZY, edit.; with contributions by several Hungarian scholars. **A Geographical, Economic and Social Survey of Hungary.** (Publications of the Hungarian Geogr. Soc.) 121 pp.; maps. "Pátria" Press, Budapest, 1919. 6 crowns. 9½ x 6¼ inches.

Before the outbreak of the war the Hungarian Geographical Society had published a work whose title in English is "A Geographical, Sociological, Cultural and Economic Description of the Crown Lands of St. Stephen." The main object of publication was "to have it translated into foreign tongues and thereby to propagate a knowledge of the Hungarian kingdom based on authentic data." The volume listed above is an extract of that part of the work dealing with Hungary proper prepared for the peace negotiations. While naturally propagandist in character, it gives much useful descriptive and statistical matter—notably in the chapters on agriculture, forestry, mining, industry, and commerce.

MOROCCAN LANDSCAPES SEEN FROM THE AIR

JULES BLACHE. **Quelques aspects des montagnes marocaines.** Maps, diagrs., ills. *Rev. de Géogr. Alpine*, Vol. 8, 1920, No. 2, pp. 225–258. Grenoble.

In an earlier paper (De Meknés aux sources de la Moulouya: Essai d'exploration aérienne au Maroc, *Ann. de Géogr.*, Vol. 28, 1919, pp. 293–314) M. Blache gave an account of valuable aerial exploration in Morocco and thereby greatly added to our knowledge of the country. Previously information regarding the mountains and plateaus of Morocco had been derived from descriptions such as those of Gentil, De Segonzac, and Fischer, while it was possible to

turn to the excellent topographic maps of Algeria for accurate representations of features, which seem from the descriptions to resemble closely some of the Moroccan types of land forms. We have in the present paper a series of eighteen air photographs, comprising both oblique and vertical views and accompanied by clear explanatory descriptions, which form an exceedingly valuable aid in the study both of Moroccan geography and of land sculpture in general. For the photographs are prepared not merely as views of Morocco but also as illustrations of the mechanism of denudation processes acting on varied structures in a rather arid climate. The views are chosen from several thousand taken in reconnaissance flights by the Moroccan military aviation service. We are informed that the views show typical—and never exceptional—landscapes of the large zones they represent. These zones are as follows: The Meseta, with its two main types of country, (1) the dissected plateaus of flat-bedded sediments and (2) the Jebilet, or residual hills of crystalline rocks which project through sediments; the Central Atlas Mountains; the plain of the upper Moulouya to the east of these ranges; the Great Atlas Mountains of the southwest; and the Rif in the north. A sketch map shows the location of each view.

We find the Central Atlas to be a range of simple structure—anticlinal ridges, monoclinal valleys, and antecedent gorges. The plain of the upper Moulouya is revealed as an arid region, slightly dissected by wadis with irrigated strips along them and with flat-topped tables between them. The Great Atlas south of the Moulouya again shows marked simplicity of form as well as great aridity. In the Rif a great contrast to the other ranges is presented. Evidently the structure is much more complicated. The ranges are dissected to a much greater extent; and in the photographs we see mature valleys, wide, waste-filled basins, and braided rivers.

In the oblique panorama of the dissected plateaus of the Meseta we have an excellent example of the natural contours produced by the alternate outcrop of strong and weak strata, a feature which proved so useful in plotting of form lines on maps prepared mainly from air photographs during the war in Macedonia, Gallipoli, Palestine, and Mesopotamia.

A Geographical Interpretation of Early Biblical History

William Willcocks. **From the Garden of Eden to the Crossing of the Jordan.** viii and 93 pp.; maps. Printed by the French Inst. of Oriental Archaeology, Cairo, 1918. 5s. 10 x 6½ inches.

Interesting and suggestive is this geographic interpretation of the sacred books of Genesis and Exodus by Sir William Willcocks, irrigation expert, designer of the Assuan dam in Egypt, and director of the recent British reclamation works in lower Babylonia. For thirty-four years the author has studied on the spot every episode in the Bible concerned with irrigation. He has come to the conclusion that the stories of the Garden of Eden and Noah's Flood in Mesopotamia, like that of Joseph's famine in Egypt, the ten plagues, and the exodus of the Israelites, all had to do with the control of water in these rainless lands—with irrigation systems established, tampered with, or destroyed. Along the Euphrates he found only two districts which could be irrigated by free flow all the year round and which therefore might have been the scene of the Garden of Eden. One was the reclaimed marshland above the Persian Gulf near the ancient Eridu, site of the Sumerian Garden of Eden. The second lay on the middle Euphrates between Anah and Hit, where a series of cataracts, now much degraded, enabled the benches of alluvial deposit above the present flood line to be irrigated by water drawn off above the falls. Here the author locates the Semitic, or biblical, Garden of Eden. The four distributaries of the river of Eden he identifies as the four offshoots of the Euphrates below Hit, namely, the Kerbela branch, Hindia, Saklawia, and Euphrates proper; and he explains the expulsion from Eden by the degradation of the cataracts below the level of the river terraces, which put an end to irrigation and made the banks revert to desert. It is a question, however, whether two sites for the Garden of Eden are necessary, since the Semitic story was clearly borrowed from the earlier Sumerian version.

The author is most interesting and convincing when he uses his expert knowledge to interpret the Egyptian stories of the Bible. With Cope Whitehouse he places the fortress of Ha-Uar, key of Lower Egypt in the Hyksos period, not at the gateway of the ancient military route from Philistia but at the dam across the canal connecting the Nile with Lake Moeris; because an enemy in possession of this strategic point could cut the dam, draw off the Nile into the Moeris depression, and deprive Lower Egypt of its water supply. This was the explanation of Joseph's famine. At that time Ha-Uar was the frontier fortress

between the Hyksos rulers of Lower Egypt and the Pharaohs of Upper Egypt. Joseph probably learned from a fellow prisoner of the plans being made by the Theban king to seize Ha-Uar and the regulator of the canal. Hence his prediction of the year-long famine, and the storing of grain and provisions before the campaign from the south should finally be set on foot. At last the catastrophe came: the regulating dam at Ha-Uar was seized and cut by the Theban forces; the Nile failed to overflow its banks in the Delta, and the predicted famine arrived. The recovery of Ha-Uar several years later was followed by the reconstruction of the dam and the restoration of Lower Egypt to its normal productivity.

In regard to the plagues of Egypt, the author shows that not only did they happen "in the field of Zoan," or northeastern part of the Delta, but that they might happen there today under a combination of low Niles and internal disturbances which should interfere with the irrigation system. He also proves that eight of the ten plagues could have occurred only in this northeastern part of the Delta and that they were inoperative in "the land of Goshen," or Wadi Tumilat district inhabited by the Israelites, because of the abundant subsoil water in this valley. Moses took advantage of a low Nile to tamper with the water channels in the Zoan, or Tanis district, and to bring on a succession of plagues, seven of which followed in a sequence of cause and effect.

The author rejects as impossible the traditional Red Sea route of the exodus from Egypt and revives Brugsch's theory of a course along the Pelusiac branch of the Nile across the Desert of Shur to the Mediterranean, and thence to Edom. This theory he supports with fresh arguments in which Moses again appears as an engineer hero comparable to Heracles. The term translated "Red Sea" in the Bible means reedy sea or reedy river or fluvial bog. Reference in Exodus is to an old arm of the Nile temporarily severed from the main stream, probably the Pelusiac branch, which Moses may have dammed up to flood the upper basin and drown the growing crops of Zoan and which he suddenly released to overwhelm the advancing Egyptians as they were crossing the muddy channel below the dam. Similar miracles performed by Moses as instrument of Jehovah resolve themselves into rational achievements normal to a man familiar, as Moses doubtless was, with the principles of water control.

ELLEN CHURCHILLL SEMPLE

A MEDIEVAL PERSIAN TREATISE ON GEOGRAPHY

G. LE STRANGE, transl. **The Geographical Part of the Nuzhat-al-Qulūb composed by Ḥamd-Allāh Mustawfi of Qazwīn in 740 (1340).** xix and 322 pp.; index ("E. J. W. Gibb Memorial" Series, Vol. 23, Part II). E. J. Brill, Leyden; Luzac & Co., London, 1919. 8s. 9½ x 6½ inches.

Guy Le Strange has rendered a great service to students of the historical geography of the Near East by bringing out a critical edition of the Persian text together with an English translation of this important work. Western readers are now able to gain a clear and accurate idea of what is probably the most significant medieval Persian treatise on geography.

As a whole, the Nuzhat-al-Qulūb consists of an introduction on astronomy and mathematical geography, two non-geographical books, a third book on regional geography, and a conclusion on the marvels of Iran. (See G. Le Strange: Mesopotamia and Persia under the Mongols, in the Fourteenth Century A.D., *Asiatic Society Monographs*, Vol. 5, London, 1903, pp. 11 et sqq.) Much of the Nuzhat-al-Qulūb was translated by C. Barbier de Meynard in the notes to his "Dictionnaire . . . de la Perse" (Paris, 1861). Like most of the historical and geographical writings of the Orient, it lacks originality; as Le Strange states in his preface, "Ḥamd-Allāh quotes largely from older authorities, and in most cases we possess the texts which he used. However, in many of his accounts of towns and descriptions of provinces he has added something of his own, from personal observation, to what he has translated not very accurately from the Arabic texts." He "gives a graphic picture of the lands of Īran in the latter days of the Il-Khāns" [Mongol rulers of Persia and Mesopotamia]. The wealth of topographic detail in the chapter on this part of the world is immense, and the account of Asia Minor "is unique and of unknown origin."

Furthermore, the Nuzhat cannot fail to appeal to whosoever is interested in the evolution of scientific and geographic knowledge as a whole. As an example of a type of medieval geographical treatise, this edition serves the same purpose for Persian that Reinaud's famous "Géographie d'Aboulféda" serves for Arabic geography, and we may well be sorry that Le Strange has not as yet seen fit to make the work complete in this respect by publishing a

translation of the introductory part on mathematical geography in addition to the regional chapters. Nevertheless, in the latter there are occasional striking passages. Chapter 16 (p. 180), for instance, begins with a clear exposition of the processes of erosion and the genesis of mountains:

"In philosophical works it is explained how, earth and water being mingled together, from the viscosity that is in the earth, the heat of the sun causes the same to harden, thus turning it to stone even as fire bakes the clay-brick. But the sun's heat then beginning to act on the stone, this loses its hardness and is broken up; which process continually accelerated by the succession of many nights and days cracks appear, splitting the rocks, which same are thus again turned to earth. Then by the action of earthquakes mountain peaks are demolished, while by the blowing of the winds and the running waters the soft earth is carried from one place to another, yet all that is rock and hard soil will remain fixed, whereby heights and hollows are formed, and it is these heights that are the mountain ranges."

In Chapter 18 (p. 200) there is an account of the origin of springs from rain water that contrasts very favorably with the fabulous hypotheses on this subject current in Europe at the time. There is not a little incidental weather and climate lore, and the cause of the tides in the "Seven Seas" is ascribed to the moon, although in the "Circumambient Ocean" Mustawfī believed in but one yearly tide, produced by the sun alone. Certainly Ḥamd-Allah was not averse to recording in immense detail all kinds of geographic marvels and monstrosities, but they serve to set off rather than detract from the brilliance of those gems of accurate observation and precise thought that are embedded in the pages of this work.

The Population of India: Conditions and Tendencies According to Census Statistics

P. K. Wattal. **The Population Problem in India: A Census Study.** vii and 83 pp. Bennett, Coleman & Co., Ltd., Bombay, Calcutta, and London, 1916. 1 rupee. 8½ x 5½ inches.

The author—is he a native of India?—sees the population increasing faster than the means of subsistence and believes the only remedy is "voluntary restraint in married life." But of this he has no hope.

The two-thirds of the Indians who are Hindus have the economic misfortune to be required by their religion to marry and beget sons. For they take their religion seriously. All but four per cent of the women between 15 and 40 years are married or have been married. For all India the percentage is six, for the Mohammedans largely follow the example of their Hindu neighbors. In every thousand Mohammedan girls under five years of age five are married, among Hindus 18. In every thousand between five and ten years for Mohammedans 65 and for Hindus 132 are married. Between the ages 15 and 40, 860 of a thousand Hindu women and 837 of a thousand Mohammedans live in matrimony. Forty-seven per cent of the population is married, almost exactly eight per cent more than the United States.

The Indian birth rate of 39 in a thousand is one of the highest in the world. So is the death rate of 34. The poverty of the people is extreme. The loss of children by death is little lamented, provided it does not leave the family without sons. There is no emigration from the country to speak of, and so little migration that barely nine per cent of the population are enumerated away from their birthplace. Seventy per cent of them are engaged in agriculture on little holdings of an acre or so per capita. The number engaged in manufactures is falling off as factories become more numerous, for the machines introduced displace many more hand workers than they occupy. Indian industry is in the transition stage. The factory hands do not move to town with their families but leave the family on the land while they work in town, so that large towns like Bombay are apt to have a great disproportion of men in their population. These factory hands look forward to a return to the land. The town exercises no attraction on them apart for the high, steady wages. But, as the number employed is diminishing, industry cannot be said to be directly increasing the national means of support.

It has been said India has much waste land to reclaim, especially by new works of irrigation. Wattal questions this. He finds figures proposed by different writers both for and against. He thinks there is less available land than commonly reported, except in Assam and Burma, and that further irrigation is of nearly prohibitive cost.

Indians of all ages have far less expectation of life than Englishmen in England; worse still, the Indian expectation has been diminishing these twenty years while the Englishman's has been increasing. In 1911 an Indian 20 years of age had a life expectation of 27.5 years—one year less than he had in 1901. The Englishman of the same age in the same period had increased his expectation from 41 to 43.7 years.

It is a sad picture. Not all the census figures are sad though. One table shows wages in India between the years 1900 and 1912 rising from 119 to 166, while the average of prices had only risen from 122 to 141. In England in the same period wages rose from 100 to 103 and prices from 100 to 109. Wattal thinks this peculiar though he has no reason to doubt the figures. Another datum that troubles him is the number of people to a house. It has fallen during the last three decades from 5.8 to 5.4, 5.2, and 4.9. Surely that is a gain.

Another comforting fact that the author does not mention is that the census shows Indian population growing at the rate of 2,000,000 a year, 8,000,000 since the book was written, and still it has found subsistence. If the limit of food is near, surely there must be evidence on every hand in India that famines are more frequent and that life is harder than formerly: the author offers none.

However, his main point is beyond doubt. India has too high a birth rate.

MARK JEFFERSON

TOWN PLANNING IN ANCIENT INDIA

C. P. VENKATARAMA AYYAR. **Town Planning in Ancient Dekkan.** With an Introduction by Patrick Geddes. xxi and 199 pp. The Law Printing House, Madras. $2.00. 7 x 5 inches.

A collection of references to town and house construction in the old Tamil writings, with comments by the author. One can hardly say that old Dekkan did any town planning. There were some habitual features. Different arts and trades had streets to themselves. The elephant trainers had broad avenues to exercise their animals. The temple tended to be a central feature; and, except in river towns, there was an ample tank of drinking water containing sufficient water even if the monsoon failed. This was commonly bordered by trees and gardens, in which beauty was prized but "sanitation" was sought—in an oriental way. Punnai trees were planted by the seashore, because this tree grows "in sandy soil. Its smell keeps off the bad odours of fish." Trees bearing nutgalls were valued for planting alongside the water tanks because the tannin in their fruit gives a "slightly sweet taste to the water and thus masks any excess of chlorine in drinking water."

MARK JEFFERSON

VOLCANOES OF EASTERN BALI

G. L. L. KEMMERLING. **De Vulkanen Goenoeng Batoer en Goenoeng Agoeng op Bali.** Maps, diagrs., ills. *Jaarboek van het Mijnwezen in Nederl. Oost-Indië*, Vol. 46, 1917, Part I, pp. 50–77. Batavia.

Kemmerling's account of the two volcanoes on Bali is preceded by a study in the same yearbook (pp. 1–48) of a destructive earthquake by which the southern side of that beautiful island was visited in January, 1917. It may be here noted briefly that the earthquake had an undulatory motion and is ascribed, not to volcanic action, but to structural deformation between the up-raised chain of islands and the deep floor of the adjacent Indian Ocean. It is reported that 74,000 buildings, or 90 per cent of the total number, were overthrown or injured, 1,358 persons were killed, and 1,060 wounded. Great damage was done by landslides, of which a number of good views are given, in unconsolidated volcanic deposits on the sides of ravines and on the inner ring-wall slope of the Batur (Batoer) caldera.

Both the volcanoes described are in the eastern part of Bali. Gunung (Mount) Agung, or the Peak of Bali, is a fine young cone of regular form, 3,142 meters in altitude, with a summit crater ½ kilometer in diameter; the long exterior slopes, largely built of lavas, are little dissected. The Gunung Batur mass, farther west, is much more complex. It consists primarily of the remains of a great cone, the top of which has broken down to caldera form, but the caldera is now more or less filled with the products of later eruptions; the down-wash of recently erupted material from the exterior slopes of the remnant cone has largely contributed to the aggradation of the piedmont lowlands. The caldera bears the marks of two engulfments; the earlier one produced a ring wall of elliptical outline, 13.8 and 10 kilometers

in diameter, and varying in altitude from 1,267 to 1,745 meters, the highest point being on the north. The inward slope of the wall, probably much decreased by fragmental materials from later eruptions, leads by a gentle declivity to a caldera floor about 1,400 meters in altitude on the north but less on the south. The later engulfment produced a smaller circular caldera, 7 kilometers in diameter, in the floor of the earlier one; steep walls, 200 or 300 meters high and more or less ravined, separate the two. So much as now remains of the earlier floor, or Kintamani terrace, is of over-crescentic, or horseshoe, form, narrowest southwards, as the later caldera is somewhat excentric with relation to the earlier one.

Several good-sized cones were built after the breaking down of the original volcano. One of the earlier is Gunung Abang, which surmounts the western side of the main ring wall with a summit of 2,152 meters; its western slope is moderately ravined; its eastern side was broken down by the later sinking of the deeper caldera floor. Important later eruptions produced the confluent cones of Gunung Batur proper, consisting partly of lavas but more largely of fragmental materials, in the center of the later caldera: the higher cone to the north is 1,717 meters in altitude, the lower one, 1,589 meters; each cone has a crater, and each crater wall is highest on the north. The latest lava flow came from the lower cone in 1905 and now covers a southeastern part of the lower caldera floor; but a larger part of the floor, between the central Batur cones and the Abang halfcone on the west is occupied by a crescentic lake of deep blue or green color, which adds greatly to the beauty of the view from the ring wall and makes it one of the finest volcanic panoramas in the Archipelago. The lake surface is about 7 kilometers long by 2.5 kilometers wide and has an area of 15.5 square kilometers. The water is fresh although the lake has no visible outlet; its level rises somewhat during the southwest monsoon. Hot springs occur near the lake and are reported to be of medicinal value. The Batur cones are barren, but the caldera floor and rim wall have more or less vegetation and are in part populated and cultivated.

W. M. Davis

Land Forms of Northwestern Sumatra

W. F. F. Oppenoorth and J. Zwierzycki. **Geomorfologische en tektonische waarnemingen als bijdrage tot verklaring van de landschapsvormen van Noord-Sumatra.** Map, diagrs., ills. *Jaarboek van het Mijnwezen in Nederl. Oost-Indië*, Vol. 46, 1917, Part I, pp. 276–311. Batavia.

This essay is a by-product of governmental geological surveys in Atjeh, the northwesternmost province of Sumatra. The province is 370 kilometers long, northwest-southeast, and about 100 kilometers across, with a full-length coast to the southwest, a somewhat shorter east-west coast that truncates the end of the great island obliquely, and a short northeast coast. The boundary between Atjeh and the adjoining province runs irregularly a little east of north. The essay gives gratifying evidence that modern methods of physiographic analysis are applied by competent investigators in the Dutch East Indies in a thoroughly appreciative manner. Three subdivisions of the province are recognized: (1) The high mountains of the interior, composed of schists and bedded rocks with altitudes of from 1,400 to 2,800 meters and continued southeastward; (2) a bordering hilly belt of variable width, composed of more or less folded sedimentary strata, generally of small resistance; and (3) a low and narrow coastal plain. Volcanic features are irregularly distributed over the three subdivisions.

The late mature or aging forms of a former cycle of erosion are preserved in the highlands in the interior mountains, where rounded summits maintained by the more resistant rocks rise to moderate heights over broad high-level depressions which represent subsequent valleys following belts of weaker rocks; but in consequence of a central upheaval of about 1,000 meters the broad high-level depressions are now incised by deep, early-mature valleys, in which the main rivers are generally graded and have only occasional rapids. Waterfalls are, however, still retained in the upper courses of the side streams, which descend to the main valleys between hilly spurs, the flat tops of which record the present altitude of the former broad valley floors. The upheaval of the region decreases outwards from the central mountains, for the hilly belt has altitudes of only 400 meters next to the mountains and of about 50 meters near the coast. This movement increased the size of the original island by adding some of the adjoining sea bottom to it, especially on the northeast where the added belt is broadest and uninterrupted; it is narrowest on the southwest, where some of the mountains reach the coast in bold headlands. The strata of the hilly belt are chiefly clays

and marls, with occasional conglomerates; they are most folded and most eroded near the mountains, where subsequent valleys are developed along certain anticlinal axes; they are less folded and eroded near the coast, where structural arches and troughs are still expressed in the topography although the arches are well dissected by consequent streams and are cut across in antecedent fashion by the large rivers from the interior. The folded structure has been carefully studied, as some of these strata bear petroleum. Occasional hard beds form cuestas and ridges, but the strata are usually so weak as not to exhibit their folded structure in their surface forms. Here the soils creep and slide so readily down the slopes, especially in cleared districts and at times of heavy rains, that many valley floors are unevenly aggraded and converted into morasses, in which the streams are broken up and confused with the ground water; such valley floors are used for rice culture. The larger valleys, in the mountains as well as in the surrounding hilly belt, exhibit along most of their length the effects of intermittent upheaval in well-defined but discontinuous terraces at two levels; the higher one from 90 to 120 meters, the lower one from 30 to 50 meters, over the rivers. Corresponding wave-cut terraces and wave-built beaches, associated with coral-reef patches and shell deposits, are seen along the outer slope of the hilly belt at heights of 100 and of 40 meters: the coral-reef patches grow up from gravel beds. Low terraces in the main valleys are attributed not to a revival of erosion in consequence of recent uplift but to river floods, although some of the rivers are still deepening their beds. The low coastal plain is from 3 to 30 kilometers wide and from 10 to 15 meters above sea level at its inner border; it is here and there extended by the growing deltas of the larger rivers and by the growing marshes of lagoons enclosed by offshore sand reefs.

Volcanic activity, long continued, has intermittently and unsystematically superposed various features upon the forms above described. Several great cones have been formed in the different areas; one of the largest, Geureudong, is a complex mass which rises over the interior mountains inland from the mid-length of the northern coast; it is broadly truncated at an altitude of 3,260 meters (as if it contained an extensive crater); one of its lateral cones bars the upper course of a river and thus forms Laut Tawar lake, formerly larger than now, but still some 25 kilometers in length. A similar lake in another valley, now drained, is recorded in shore terraces and deltas. Extensive mudflows of volcanic agglomerates and tuffs, from 10 to 50 kilometers in length, bury parts of the hilly belt or flood its valleys, thus more or less completely extinguishing its relief; but these flows are now dissected by narrow, steep-walled ravines with cascading streams. One of the volcanic cones forms the island of We, about 10 kilometers in diameter and 730 meters in height, near the northwestern extremity of Atjeh; it is described in a special article by Zwierzycki (*Jaarboek van het Mijnwezen*, Vol. 45, 1916, pp. 1–11) as of well-dissected form, bearing three wave-cut benches, at 20, 40, and over 100 meters above sea level; the middle bench is the most distinct; it girdles the island and sometimes has a width of 150 meters. Remains of "coral banks" are found on each bench.

The photographic illustrations of the essay on Atjeh are fair; the outline figures in the text might be much better. The physiographic analysis bears every mark of accuracy; but, as it is the work of geologists, it is naturally given a geological phrasing which is avoided as far as possible in the above abstract.

W. M. Davis

Climate and Weather of the Philippines

José Coronas. **The Climate and Weather of the Philippines, 1903 to 1918.** 195 pp.; maps, diagrs. The Government of the Philippine Islands, Philippine Census, A. D. 1918. Bureau of Printing, Manila, 1920. 9 x 6 inches.

Several important studies of the climate of the Philippines have been issued during the past two decades. An extended discussion entitled "Climatología de Filipinas" (1899) was published as a part of "El Archipiélago Filipino," printed in Washington at the expense of the United States Government. An English translation appeared in Volume 4 of the Report of the First Philippine Commission to the President (1901, pp. 113–357). A summary was published in 1900 under the title "Interesting Climatological Data Concerning the Weather of Manila." To the 1903 Census of the Philippines, Rev. José Algué, S.J., Director of the Weather Bureau, contributed another report on climate, which included many of the illustrations and tables of the monograph embodied in "El Archipiélago Filipino," but revised to date. To Father Algué we are also indebted for two pamphlets on the climate of Baguio (1902, 1909). The rainfall has been discussed by Rev. Miguel Saderra

Masó, in "The Rainfall in Philippines" (1907) and "Annual Amount and Distribution of Rainfall in the Philippines" (1914). In 1915, as a contribution to the Panama Pacific International Exposition, Rev. José Algué issued a pamphlet showing, on a map, three types of climate based on the monthly distribution of the rainfall and considered the characteristics of each type.

The present monograph is a new and original study, prepared for the Philippine Census of 1918. It is not only remarkably complete in all details, including many which are often omitted in climatic discussions, but it also lays special emphasis upon the weather conditions. Climate being average weather, a knowledge of the weather types which, taken together, go to make up any climate, seems to us absolutely essential. In climatological progress of the last decade, one of the most marked tendencies has been the increasing emphasis laid upon the weather element, with the result that recent studies have given far more complete, vivid, accurate, and withal interesting pictures of the climates with which they deal than was formerly the case.

This Report presents more data and deals with more stations than any previously published on the climate of the Philippines. Special emphasis is laid on rainfall, which is the most critical element of the climate in a region whose temperatures do not vary widely. The types of monthly distribution of rainfall are shown by means of a series of curves, and an interesting "climate map" indicates, by colors, the two main and the two intermediate types of rain distribution. On this map a novel and ingenious method of showing the annual amounts of rainfall is employed. These amounts are entered, for each station, in very legible figures, in color according to the amounts, the four colors used indicating rainfalls of under 1,500 mms., 1,500–2,000 mms., 2,000–3,000 mms., and over 3,000 mms. The resulting map presents the facts of annual rainfall and of rainfall types in a singularly clear and effective manner. On a somewhat similar scheme, the essential temperatures are shown. At each station there are three sets of figures, printed in a column. The first is the mean annual minimum; the second (in red) the annual normal; and the third the mean annual maximum. This map shows the temperatures very simply and clearly.

The typhoons which affected the islands during the period of 16 years are distributed by provinces and subprovinces, the tracks of remarkable typhoons being plotted. Accounts are given of all the principal floods and periods of drought experienced during the period. A page of curves of monthly mean temperatures for selected stations in Europe, the United States, and the Far East illustrates the steadiness and small ranges of the temperature in the islands. Several wind roses show the seasonal changes in wind direction, and bring out clearly the monsoon tendencies.

This new and interesting report will be welcomed as one of the important publications on climatography of the last dozen years. We commend it as a model of what a climatographic discussion should aim to be.

R. De C. Ward

An Ethnographic Handbook on the Philippines

A. L. Kroeber. **Peoples of the Philippines.** 224 pp.; maps, ills., bibliogr., index. (Amer. Museum of Nat. Hist. Handbook Ser. No. 8.) New York, 1919. 8 x 5½ inches.

This volume of the admirable Handbook Series of the American Museum is the fourth dealing with primitive races. The first three treated of restricted culture areas in North America, while the present volume deals with an area of entirely different character.

As the introduction points out, the Philippines present a field of exceptional interest to the student of the development of social culture inasmuch as they preserve a remarkable "stratification" of civilizations. The most recent "layer" includes the religious and cultural features of the Christian epoch dating from the Spanish conquest of the Islands in the later sixteenth century. Mohammedanism came two centuries earlier and still maintains its sway in the southernmost parts of the island group. More profound are the influences material and spiritual that, emanating from India, spread throughout the East Indies and probably reached the Philippines mainly by native channels of transmission. Contemporaneously there were relations with southern China, apparently on the material side alone. "There is not a single institution, piece of knowledge, or religious belief current in the Philippines that can be derived with any certainty from China." Below these is the stratum of primitive Malayan culture, and there are remnants of the still earlier culture known as Negrito.

Dr. Kroeber gives an illuminating exposition of the principal facts regarding the native

civilizations and the racial and linguistic characteristics of the Philippine peoples, placing the whole in an adequate geographical setting. The paragraphs on population density and distribution (accompanied with map based on the census of 1903) are specially interesting.

Population even in pre-European times was comparatively dense. The lowest computation gives five per square mile, a figure greater than that for any parts of the aboriginal New World except parts of Mexico and Peru. Under Spanish rule population increased in the main because of removal of social causes militating against increase—piracy, human sacrifice, head hunting, etc. Comparatively little was done to render more land available for cultivation or to improve the yield from cultivated areas. The possibilities in these latter directions are enormous. The subprovince of Ifugao in the interior of northern Luzon, with an area of some 750 square miles of which less than 50 square miles are actually cultivated, is estimated to contain 132,000 inhabitants. This means that more than 2,000 people are supported by each square mile of cultivated land—a density rendered possible by the skilled works of terracing and irrigation that are astonishing achievements for so distinctly primitive a tribe as the Ifugao.

Vegetational Studies on Philippine Mountains

William H. Brown. **Vegetation of Philippine Mountains: The Relation Between the Environment and Physical Types at Different Altitudes.** 434 pp.; map, diagrs., ills., index. *Manila Bur. of Science Publ. No. 13*, Manila, P. I., 1919. 9½ x 6 inches.

As the title implies, this is an attempt to relate the vegetation of different altitudes to the environment by measurement of the various climatic and soil factors. Most of the study is devoted to Mt. Maquiling, an isolated extinct volcano, 1,140 meters high, situated 64 kilometers southeast of Manila. A briefer study was also made on Mt. Banahao, 2,300 meters (pp. 391–405).

The vegetation of the slopes of Mt. Maquiling is divided into four types as follows: (1) *parang*, a Tagalog term for mixture of second-growth forests and grassland in early stages of recovery from former clearings, around the base of the mountain and extending up the slopes to an altitude of 200 meters; (2) dipterocarp forest, from the edge of the *parang* to an altitude of 600 meters; (3) mid-mountain forest, from 600 meters to 900 meters; and (4) mossy forest, on the top of the mountain and bathed in clouds for a large part of the time. A general description is given of each one of the vertical zones of vegetation.

Small plots, usually .25 hectare in area, are laid out, and a census of the vegetal population is taken. In this census, probably the most complete ever taken in a tropical forest, the well-known arrangement of the forest into stories is recognized, and the number of tree species of each story is recorded. For instance in the dipterocarp forests three stories are thus enumerated. The height of the tree, its diameter, and the length of the bole are measured; and from these data the volume of the wood is obtained. These figures show that, while the plot contains 92 species, only a few of them have the capacity to reach, when mature, the upper story, making it comparatively simple in composition. This is a confirmation of the investigation of the writer of this review made in tropical forests of both hemispheres and is of great importance from the standpoint of the lumberman, for trees of the upper story are usually the only ones of sufficient size to utilize on a large scale.

As one ascends any tropical mountain, it will be noticed that the height of the forest and the number of stories diminish. Brown's measurements show that in the dipterocarp forests (three stories) the tallest tree is about 40 meters and the average height of the top story is 27 meters; in the mid-mountain forest (two stories) the tallest tree of the first story is 22 meters and the average height is near 17 meters; while in the mossy forest (one story) the tallest tree is 13 meters and the average height is about 6 meters.

In order to explain, if possible, the interrelations of the different classes of vegetation at the same and at different altitudes extensive measurements of the environmental factors were made at five stations at different altitudes. In this way comprehensive data, more complete than ever before undertaken in any tropical country, were obtained of the temperature, light intensity, rainfall, soil moisture, humidity, evaporation, and wind velocity. In some instances instruments in the same station were set up at different heights from the ground, thus giving data concerning the local climate in different layers of the atmosphere. The readings extended over a period of some two years.

Some of these results may be briefly indicated. As one would suppose, the temperature decreases from the lower altitudes to the higher. The average daily maximum is as follows: at 80 meters, 29.2° C.; 300 meters, 25.1° C.; 450 meters, 24.3° C.; 740 meters, 23° C.; 1,050 meters, 19.3° C. Owing principally to more frequent cloudiness at the higher altitudes the light intensity decreases from the base of the mountain to the top. The average daily light intensity in tops of dominant trees at different elevations, as measured by the difference between the evaporation from the white and from the black Livingston atmometer, is as follows: at 80 meters, 6.4; 300 meters, 5.9; 450 meters 5.1; 740 meters, 4.; 1,050 meters, 2.8. These figures show that the light intensity is 2.3 times as great at the base as at the top. The rates of growth and the heights of the trees at different elevations show a general agreement with the light-temperature indices; viz., with the product of light intensity multiplied by temperature indices for growth. In fact, Brown thinks that the lower temperatures and the lower light are the main factors in producing the lower growth of the higher altitudes. Of these the diminished light of the higher altitudes of Mt. Maquiling has, according to the author, the most influence; for the differences in temperature are not great enough to have an appreciable effect. Rainfall is greatest at the middle elevations, while evaporation decreases with altitudinal increase. The moisture content of the soil increases with altitude. At the base it is low enough to become harmful for vegetation.

The article is full of interesting discussions, sometimes speculative, although always based on some data and admitting that the conclusions reached must be verified by further studies. The quantitative description of the vegetation and the measurement of the different factors of the habitat are so exhaustive as to leave no doubt that the work has been well done. The records are all published in great detail; for, as the author states, "it is believed they will be of value in presenting an actual picture of environmental conditions, and they may be of service in the future in interpreting the relation of environment to different types of tropical vegetation in a more exact manner than is now possible."

H. N. WHITFORD

NATURE AND MAN ON CAPE COD

A. P. BRIGHAM. **Cape Cod and the Old Colony.** xi and 284 pp.; maps, diagrs., ills., index. G. P. Putnam's Sons, New York and London, 1920. $3.50. 8 x 5½ inches.

Professor Brigham states that his object in writing the story of Cape Cod and the Old Colony was to show "the way men have used these lands and waters and come under their influence," to show "how the first colonists and those who followed them have adjusted themselves to the mobile conditions of nature and of man." This object he has accomplished acceptably, within the limits imposed by space and by the popular audience for which he has written. The physical history of the Cape, with its moraines and outwash plain, its dunes and lakes, its varied and ever changing shore line; the coming of the Pilgrims and the gradual extension of settlements around the Bay; and the changing relations of the people to land and sea through three full centuries—all are woven into a story told in a simple and charming manner for the general reader. Professor Brigham frankly admits that "the Cape cast its spell upon him." Its splendid views, its superb summer air, and its friendly people naturally appealed powerfully to such a lover of nature and of worthy men. And so he is always "sympathetic," perhaps at times unduly so, in his consideration of the activities, character, and outlook of the people of the Cape.

The early colonists were farmers; though most of their settlements were located upon the shores of harbors for purposes of communication and trade, they looked chiefly to the soil for a living, securing for a time good crops of corn and other grains. Where practicable they planted their gardens and fruit trees in the valleys, behind hills, or in kettle holes, as a protection against the ocean winds. Presently, however, agriculture lost its dominance in the economic life of the region, and it continued to decline through many years. Though "too much has been said about the poverty of the Cape soils," it is apparent that from the outset they were relatively poor in many places, and in spite of the use of marine fertilizers their yields decreased because of continuous cropping and of increased wind erosion consequent upon the removal of much of the scanty forest. Other occupations paid better than farming; and, as the population increased, more and more of the people turned to the sea. Increasingly in later years the Cape looked for its food supplies to the interior, with whose rich lands it could not compete in the production of staple crops. Many farmers moved to the prairies, and of late less than a fifth of the Cape has been in farms.

The earlier decline of agriculture and the growth of maritime activities were concomitant processes. The shore villages became thriving communities, whose fishing smacks gathered in the harvest of the offshore waters, whose whalers extended their operations even to polar regions, and whose merchantmen visited the ports of every sea. But in time the decline of these sea interests set in; for various reasons fishing has become of slight importance, whaling has ceased, and commerce has sought deeper harbors with better connections inland. As a result emigration increased, and the population of the Cape diminished until in 1910 it was less than in 1830.

Forced after many years to turn again to the land, the reduced population of the Cape has in later days found profitable employment in ministering to the needs of summer visitors and in growing special crops, particularly small fruits, suited to the climate and soil. The future prosperity of the Cape apparently will depend largely on its scenery and its summer climate, "on the summer boarder and the summer homemaker."

The reader unfamiliar with the Cape will wish that a more helpful map than that at page 24 had been provided. It is not easy to read, no scale is indicated, and many places and features mentioned in the text are not shown or are not named. [Compare the map illustrating Professor Brigham's article "Cape Cod and the Old Colony" in the July, 1920, number of the *Geographical Review*.] While there are many allusions to a few well-known sources of information about the Cape, definite citations are almost wholly lacking. If footnote citations are inappropriate in a book of this kind, a note on sources at the end would have been valuable to serious readers. The failure of the Cape ever to develop important manufacturing interests (other than salt-making from sea water), in spite of its proximity to the great industrial region of New England, is emphasized but inadequately explained. One feels that Plymouth receives scant attention after the account of the landing of the Pilgrims, and occasionally one is in danger of losing interest in the minute descriptions of places. It is safe to say, however, that few will read the book without resolving to visit or revisit this historic ground.

HARLAN H. BARROWS

THE CZECH ELEMENT IN THE UNITED STATES

THOMAS ČAPEK. **The Czechs (Bohemians) in America: A Study of their National, Cultural, Political, Social, Economic, and Religious Life.** xix and 294 pp.; maps, ills., bibliogr., index. Houghton Mifflin Co., Boston and New York, 1920. 8½ x 5½ inches.

The title of this study inevitably arouses comparison with its well-known precursor, Faust's "German Element in America," and unfortunately so, for it is not the epoch-making work that Faust's was. This is not altogether the author's fault, for his subject is less broad and more recent than that of the pioneer in the field of racial group cross sections of American life. Czech immigration as a significant factor in the social life of the United States is a matter of the last eighty years, and the number of immigrants and their descendants is relatively small even now. Granted that mere numbers do not measure the moral weight of a community, the other factors are nevertheless so intangible as to be difficult of evaluation without a perspective furnished by lapse of time. For these reasons the study is clouded by a multitude of personalities and of inconsequent details which partly obscure its conclusions.

This does not, however, deny value to the work. On the contrary, it represents a faithful and sympathetic portrayal of the most intimate details of Czech life in the United States from the days of the first immigrants. To an individual of Czech ancestry it will be a loving reminder of heroic days; to the general student of conditions in the United States it will serve as a source book for certain social origins of interest to the historian, the sociologist, the economist, the theologian, and the geographer.

Leaving aside points of interest to other general or special students, the geographer will find here and there useful facts or significant statements. Chapter 3 is devoted to the causes of emigration and of immigration during the two decades after 1840. The routes followed from the old land to the new and the reasons for selecting this or that place within the United States as sites for future homes, are traced with care and afford a basis for generalizing on the relative importance of geographic and non-geographic factors in determining these important steps of the immigrant. The principal contribution of the book to the field of geography is its study of the distribution of the Czech stock within the United

States. Chapter 4 is a tabular résumé of population statistics, illustrated with a dot map; Chapter 5 makes scattering additions to this fund of geographic information in a study of the distribution of the stock by trades; Chapter 17 recites the distribution of churches and churchgoers. Together these sections furnish a basis for comparison with similar data on other races. A comparative study of the distribution of immigrant races within the United States would be invaluable.

Not the least worth-while section of the book is the appendix, a bibliography of printed material on the Czech in America.

D. L. WHITTLESEY

CHAPTERS IN THE EARLIER COLONIAL HISTORY OF LOUISIANA

N. M. M. SURREY. **The Commerce of Louisiana During the French Régime, 1699–1763.** 476 pp.; maps, diagrs., bibliogr. (Columbia Univ. Studies in Hist., Econ., and Public Law, Vol. 71, No. 1.) Columbia University, Longmans, Green & Co., Agents, New York, 1916. $3.50. 10 x 6 inches.

This extended account of the commerce of Louisiana during the French period will be of value to students of the historical geography of the United States, for it is the first systematic discussion of all branches of that commerce and is based largely on unpublished documents. In Chapter 1 Dr. Surrey briefly outlines the exploration and settlement of the interior by the French. In Chapters 2 to 6 she notes the river routes and portage paths of the region, depicts the difficulties and methods of navigating the rivers, describes the various types of boats used, and considers the principal land routes, most of which had served as buffalo paths or Indian trails. Chapters 7 to 11 are devoted to "commercial processes," especially to the method of barter always used in the Indian trade, and to the rôle of silver, copper, and paper money and of credit in the other trade. The remaining chapters of the book (12 to 25) describe the trade between Louisiana and France, the slave trade, the domestic trade of lower Louisiana, the trade of the Illinois country, the fur trade (as developed by the French of Canada and the English of the eastern seaboard as well as by the settlers of Louisiana), and the less important trade of Louisiana with the French West Indies, Mexico, New Mexico, Texas, Florida, and Cuba, and with the English.

The non-geographic factors affecting these various branches of the trade of Louisiana are set forth in much detail, as are the facts concerning fluctuations in the prices of commodities, changes in the fortunes of rival traders, and similar matters. But the author ignores or recognizes inadequately many of the geographic conditions which influenced the development of the trade. Thus, in the pages devoted to the bitter rivalry between the French and the English for control of the fur trade of the lower lake region and the Ohio basin, one looks in vain for adequate recognition of the importance (1) of the relations of the St. Lawrence lowland and the Hudson-Mohawk depression as rival routes from the seaboard to the northern interior and (2) of the relations of various tributaries of the Ohio River to east-flowing, antecedent rivers of the Appalachians as affecting the western operations of the traders of Pennsylvania and Virginia. So obvious an influence in the trade of the Mississippi River as that of climate in differentiating the agricultural products of lower Louisiana and the Illinois country is ignored. Though a chapter is devoted to waterways and another to exploration and settlement, the outstanding facts (1) that the waterways made possible the rapid exploration of the interior by the French and largely determined the lines of their advance and (2) that the geography of the waterways fixed the location of most of their trading posts, are not made clear.

Maps showing the location of the French posts noted in the text, of the portage paths enumerated, and of the many Indian tribes referred to, as well as an index, would have added much to the usableness of the book. On a crude map showing the approximate courses of certain trails, Detroit is located on the site of Port Huron, Fort Malden is represented as at the mouth of the St. Clair River, Danville appears in Indiana, and Peoria has been shifted to the eastern side of the Illinois River, while similar liberties have been taken with other posts and towns. The reviewer long has wondered when the fraternity of historians will recognize the importance of providing and effectively using maps, accurate maps, in historical works.

Dr. Surrey says in the preface, "In elaborating the theme an effort has been made to bring together all that is pertinent and available in French and English records." In view of this painstaking search for data, one is surprised to find no reference in the bibliography

or the footnotes to such studies as Turner's "Character and Influence of the Indian Trade in Wisconsin," Quaife's "Chicago and the Old Northwest," Hanna's "Wilderness Trail," or Alvord and Bidgood's "First Explorations of the Trans-Allegheny Region," the more so as such a doubtful authority as Parrish's "Historic Illinois" is cited several times. Dr. Surrey has, nevertheless, brought together a multitude of useful facts, most of them not readily available elsewhere, which no future student of early Louisiana can afford to ignore.

MARC DE VILLIERS. **A History of the Foundation of New Orleans (1717–1722)** Transl. from the French by Warrington Dawson. Maps, ills. *Louisiana Hist. Quart.* Vol. 3, 1920, No. 2, pp. 157–251.

The history of New Orleans may be said to commence with the year 1702 when De Remonville proposed the creation of a post at the "Mississippi Portage" (i.e. from Lake Pontchartrain). The date of the foundation "may be fixed at pleasure anywhere between the spring of 1717 and the month of June, 1722," the latter date following the decision that raised the town to the rank of capital. The vicissitudes of these years, which include the great flood of 1719, are here recounted.

GUIDES TO THE WEST INDIES

F. A. OBER. **A Guide to the West Indies, Bermuda, and Panama.** 3rd revised edit. ix and 533 pp.; maps, ills., index. Dodd, Mead & Co., New York, 1920. $3.50. 7 x 4½ inches.

K. J. BURDON. **A Handbook of St. Kitts-Nevis, a Presidency of the Leeward Islands Colony, Containing Information for Residents and Visitors Concerning the Islands of St. Christopher or St. Kitts, Nevis, and Anguilla.** viii and 247 pp.; maps, ills., index. The West India Committee, London, 1920. 7 x 5 inches.

"A Guide to the West Indies, Bermuda, and Panama [the Canal Zone]," first published in 1908, is here brought up to date. For the tourist it is a comprehensive and useful volume. It might, however, be improved by the inclusion of more and better maps.

The handbook on St. Christopher (St. Kitts), Nevis, and Anguilla, which islands together constitute a Presidency of the Federal Colony of the Leeward Islands, is written by the wife of the present administrator. Mrs. Burdon has made good use of her opportunities to bring together in convenient form a large body of miscellaneous information useful to the traveler and in places suggestive to the geographer. Though small, the islands (area 155 square miles) have had an interesting and varied history; and this is described at some length. There are separate maps of the islands on the scale of 2 miles to the inch, and there is a reproduction of the "oldest known map of St. Kitts."

THE VEGETATION OF PARAGUAY

R. CHODAT. **La végétation du Paraguay: Résultats scientifiques d'une mission botanique suisse au Paraguay.** In collaboration with W. Vischer. Vol. 1, 157 pp.; map, ills.; Vol. 2, pp. 158–290; ills. Imprimerie Jent, Geneva, 1916, 1917. 9½ x 6½ inches.

Because so little is known as yet about the general vegetative features of Paraguay, anything that will throw light on the subject is welcome to the ecologist and the plant geographer. While the recent publication of Chodat helps to some extent in giving glimpses of the vegetation of this country, it falls short of containing a comprehensive view of the general vegetative features. In a brief introductory chapter on climatology and physical geography there is an attempt to relate the vegetation to these two groups of factors, accompanied by a small sketch map of that part of the country east of the Paraguay River showing inadequately, except for limited areas, the physical features. This map does not show the vegetative types accompanying such features. From the text it is gathered that, generally speaking, the country is divided into two physical types, the low more or less swampy lands occupying the Paraguay portion of the Gran Chaco region west of the Paraguay River and in places as belts of greater or less extent on the western side of the river. This type has a vegetation similar to that of the Gran Chaco region of Argentina. The rest of the

country is a dissected plateau, with a more or less continuous range of comparatively low mountains stretching from north to south and dividing the country into two unequal parts, the Paraguay and Paraná drainage regions. This plateau, according to the author, lowers gradually from the north to the south; at Punta-Pona near the northeastern corner it is 660 meters above sea level. At Ipé Hu it is 420 meters; at Caaguazú near the center it is 300 meters; and at Encarnación in the southeastern corner, at the big bend of the Paraná River, it is 120 meters.

The plateau region contains a subtropical rain forest generally speaking; that to the east of the divide is better developed than that to the west, but both forested regions are interrupted by grasslands and savana forests. The main part of the report deals with autecological rather than synecological problems; that is the species are treated as individuals rather than in communities. The publication is well illustrated with pen sketches and reproductions from photographs, which give one a better idea of the vegetation than the text; and with numerous drawings of the microscopic features of the plant tissues. Some new species are described.

H. N. WHITFORD

AN IMPORTANT CONTRIBUTION TO THE GEOGRAPHY OF ARCTIC ALASKA

E. DEK. LEFFINGWELL. **The Canning River Region, Northern Alaska.** With a preface by A. H. Brooks. 251 pp.; maps, diagrs., ills., bibliogr., index. *U. S. Geol. Survey Professional Paper 109*, Washington, D. C., 1919. 11½ x 9 inches.

The region that Mr. Leffingwell describes lies on the northern coast of Alaska facing the Arctic Ocean and about 60 miles west of the International Boundary. A more bleak or inhospitable place could hardly be imagined, but the author must have been actuated by a great love of arctic nature for he kept going back to the region time after time, so that during the ten years between 1905 and 1915 he spent six winters and nine summers there, and all at his own expense. His work and observations covered a very wide range. He made a reconnaissance, a topographical and geological map of a rectangle 70 miles square, and examined the geological structure; he made a map of the coast line for 300 miles, along one-half of which he carried a network of triangles; he determined his latitude with a probable error of a fraction of a second and his longitude by lunar occultations with a probable error of 7 seconds. He made soundings through the ice to a distance of about 100 miles from shore; the continental shelf extended out about 50 miles, and there he found a sudden change of depth from 30 to 320 fathoms in a distance of 2½ miles. Beyond this his line of 320 fathoms found no bottom. Captain Mikkelsen, who was with him the first year, made careful tidal observations; and Mr. Harris, of the U. S. Coast and Geodetic Survey, found that they supported the idea of extensive land in the Arctic Ocean to the north. This land has never been seen, but we must remember that the region where it is supposed to be has not been explored.

Mr. Leffingwell tells us of the climate and of the animal life and gives a long discussion of the ground ice; but let us summarize some of his results.

The region he studied partially bridges the gap between the region examined by the geologists of the International Boundary Survey on the east and that examined by the geologists of the U. S. Geological Survey on the west. All these studies show that the general structure of northern Alaska trends about east and west and is fairly continuous from the International Boundary to Cape Lisburne. Topographically the Endicott Mountains form the watershed between the Yukon River and the Arctic Ocean; the range is known under special names in its different parts. North of this is a piedmont plateau and then a coastal plain. In the region examined by Mr. Leffingwell these three provinces are separated by scarps which give the appearance of faults, but which in places may be steep folds. The main mountain range is made up of strongly folded schists of pre-Carboniferous age with some igneous intrusives. It rises to a general height of about 6,000 feet, with a few peaks as high as 9,000. The higher parts are covered with snow giving rise to numerous glaciers. These, however, could not be explored, but, according to Mr. Leffingwell's pictures and descriptions, they have no peculiar characteristics. In front of the Endicott Mountains, between the Canning and Okpilak Rivers, are three mountain ridges made up of folded Carboniferous limestones and sandstones, with gentle slopes towards the south and steep slopes to the north; their surfaces seem structural; they strongly suggest tilted blocks. They end abruptly, their folds apparently plunging down at both ends. In front of the

mountains the piedmont plateau, but little dissected, consists of upturned and planed-off Mesozoic and Tertiary strata; and the coastal plain down to the ocean is a flat featureless plain of very recent deposits. The rivers are parallel and closely spaced, all flowing across mountains, plateau, and plain to the Arctic Ocean; they give the impression of simple subsequent streams, though their origin is not entirely clear. There seems to have been no deformation of the region at the end of the Paleozoic; but since Jurassic or Cretaceous times, and to the end of the Tertiary, it has suffered many disturbances with more or less peneplanation in between.

The description of the general erosion of the region and of the formation of sand bars and spits along the coast, etc., indicates no material difference from temperate regions; but in the frozen ground of the tundra we find a phenomenon peculiar to the far north.

The subject of ground ice and frozen ground is treated very fully. The observations of previous writers are summed up and largely quoted. Middendorff's studies of the Schergin shaft in Siberia, which are not easily accessible, are given in some detail. This shaft was sunk at Yakutsk, Siberia, in the early part of the last century with the hope of finding water for the town, but it did not penetrate below the frozen ground even at a depth of 382 feet. In 1844–1846 Middendorff made extensive observations on the temperature in the wall of the shaft at various depths below the earth's surface. The general result showed a temperature gradient which flattened out with depth and seemed to indicate, by its steeper gradient near the surface, that the mean annual temperature of Yakutsk had been recently lowered by nearly 5° C. at the time of Middendorff's observations. In Alaska several shafts have been sunk about 200 feet, and one reached 365 feet, without penetrating below the frozen ground. Various theories as to the origin of this condition are discussed, and the attempt is made to determine the age from the temperature gradient; but with little success, for much detailed data are needed which are not available. Nevertheless the attempt is interesting and may sometime yield more definite results. The "ground ice wedge" is an interesting form which is apparently widespread in the northern tundra. The ice occurs in the form of wedges very free from mixture of earth. They are ten or twenty feet across at the top, a few feet below the surface of the muck, and narrow out below, apparently disappearing at a depth of twenty or thirty feet. The author connects them with the frost cracks which form with loud reports in the ground during the great cold of winter; later, water flows into these cracks and freezes; and, as the whole warms up during the summer, the expansion squeezes up the sand and clay on the sides and so produces a slightly uneven land surface broken into polygonal blocks, the frost cracks occupying the depressions between them. This process continues year after year, and the ice wedges grow in size.

Many details and interesting descriptions of ground ice, sea ice, and ice formed by the rivers and domed up under hydraulic pressure are given; but they must be passed over with a mere reference.

The difficulties Mr. Leffingwell encountered were serious. In summer he had to be his own pack horse, which interfered greatly with his excursions into the mountains; in winter, when journeys could be taken by sleds, the snow covered much that he wanted to see. One must admire the energy and enthusiasm with which he stuck to his purpose, going back year after year, improving and broadening his observations in the face of many obstacles. It is by just such persevering work as his that knowledge of the difficultly accessible regions of the earth is becoming definite.

HARRY FIELDING REID

A TEXTBOOK OF AUSTRALIAN METEOROLOGY

GRIFFITH TAYLOR. **Australian Meteorology: A Text-Book including Sections on Aviation and Climatology.** xi and 312 pp.; maps, diagrs., index. Clarendon Press, Oxford, 1920. $5.65. 8½ x 5½ inches.

Meteorologists the world over will welcome this excellent book which throughout is characterized by that originality and stimulation with which the readers of the *Geographical Review* are already familiar in Dr. Taylor's contributions. The work is primarily intended as a general textbook for students of meteorology and climatology in Australia, but, unlike most textbook writers, Dr. Taylor has written for foreign readers quite as much as for those at home. There are many valuable suggestions to the teacher, particularly on the advantage of using Australia as a climatic model to show the temperature and rainfall effects of the seasonal migrations of the sun, and, in turn, the control of the resulting climates over the

industries and distribution of population in Australia. Principles therein discovered could then be applied to the more complex climatic environments of other parts of the world. For such a comparative purpose the book is well fitted. Thus, in discussing climatology Australian homoclimes, *i.e.* the climates, products, and types of people in corresponding climates elsewhere, are cited. A world map of Herbertson's natural regions revised for Australia is presented. This chapter is admirable as an essay on comparative human climatology. Many of its interesting points are discussed more fully in the article "Agricultural Climatology of Australia" of which an abstract is given elsewhere in this number of the *Review*.

Of considerable interest also are the chapter on "Aviation and Meteorology," based largely on his own and his aviator-students' experiences, and that on "The Origin of the Tropical Lows in Australia." The low-pressure areas here dealt with form as buds from the two foci of practically permanent low pressure in summer in northern Australia. Dr. Taylor thinks that broad "convection domes" of heated air build up over these regions and from time to time have their summits torn off by the northwest anti-trades aloft and that these warm masses, having been given an eddying motion while being detached, reduce the pressure in the strata below and thus bring about the establishment of separate cyclones. He thinks that this convection-dome theory is also adequate to explain the origin of those extra-tropical cyclones which bud off from the other major centers of convection of the world, *i. e.* the low-pressure "centers of action."

There are few portions of the book open to adverse criticism. As in most textbooks on meteorology, the chapter on clouds and their origin is unsatisfactory, chiefly because of its brevity. In explaining how clouds originate, the common method, by mixture, is not even mentioned.

Two appendixes show the "Topographic Control of Rain in S. E. Australia" and "Temperature and Rainfall Averages for Australian Towns." In the front cover is a workable solar-control model; at the end a full index. Illustrations to the number of 229, most of them drawn by the author, vivify the text.

CHARLES F. BROOKS

PAPERS ON THE TIDES

W. B. DAWSON. **The Tides and Tidal Streams, with Illustrative Examples from Canadian Waters.** 43 pp.; diagrs., ills. Dept. of the Naval Service, Ottawa, Canada, 1920. 9½ x 6½ inches.

W. B. DAWSON. **Tidal Investigations: Results Deducible from the Tidal Observations.** Map. (Rept. of the Canadian Arctic Expedition, 1913–18, Vol. 10, Part C, pp. 3B–13 B.) Ottawa, 1920.

The first named paper treats the subject in a somewhat popular manner. It embraces the tide in general; the methods employed in the observations of tides and description of tidal curves; the causes of the tides; types of tides; the tides as modified by local conditions; and tidal streams as illustrated by Canadian examples. Attached to the paper are five plates illustrating the several types of tides as represented by observations at Canadian tidal stations.

Because of the scarcity of publications in English dealing with the subject of tides and tidal phenomena from the viewpoint of the layman, the present pamphlet is welcome. It is questionable, however, whether the treatment of the movements of sun and moon is not too detailed for the layman, and a like question might be raised as to the author's description of the types of tides. Furthermore, in describing tides he classifies them into three types—the synodic, the anomalistic, and the declinational. It is not certain that this classification will appear as clear to the layman as that of daily, semidaily, and mixed types.

The author calls attention to the scarcity of material dealing with the effect of wind on surface currents. In the observations made on currents in Canadian waters, where the tidal currents are generally of considerable magnitude, the current due to the wind is necessarily masked by the strong tidal effects. From this the impression might be gained that the effect of the wind in general is negligible; while, as a matter of fact, in localities where tidal currents are weak the current will generally set with the wind masking entirely the tidal effect.

The second paper covers the tidal investigations and results of the expedition (1914–1916) under the leadership of Mr. Vilhjalmur Stefansson.

Tidal observations in the Arctic regions have a value not only in extending our knowledge of the geographic distribution of the tides but also in helping to throw light on the theory of the existence of a large land mass in the Arctic, a deduction which was arrived at from scanty tidal observations.

The paper gives a concise report of the methods and results of tidal observations at ten places in the general region of Beaufort Sea, where tidal observations at best are meager, and is a welcome addition to the tidal literature of the Arctic. An appendix gives mean ranges and establishments and a map of the region showing the location of the tide gauges.

The report brings out the importance of accurate time for proper comparisons with other stations and in this respect will be valuable for the Arctic explorer, whose tidal observations are only incidental to the many varied subjects to which he must give attention. It is shown that, on account of the small range of the Arctic tides, observations should be made when possible at the time of spring tides and further that, with regard to general procedure in any future tidal observations in the Arctic regions, some permanent tidal station should be established for reference in the region and should be maintained during the time the explorations are in progress.

G. T. RUDE

TOPOGRAPHIC DETERMINANTS OF ARTILLERY OPERATIONS

W. C. CLARK, compiler. **Heavy (Coast) Artillery: Orientation.** Revised. xv and 302 pp.; maps, diagrs., ills., bibliogr. Coast Artillery School, Fort Monroe, Va. 75 cents. 9 x 6 inches.

Batteries of heavy artillery are usually located several miles behind an army's front line and direct their fire at targets which are not visible from the gun positions. Under these conditions the fire must be controlled by precise topographic methods and based on accurate, large-scale topographic maps. The procedure of making the topographic determinations necessary for map firing is called *orientation*; and the present work on heavy artillery orientation was compiled by Major Clark as a textbook for use in the Coast Artillery School at Fort Monroe, Virginia, and in universities giving preliminary military training.

The representation of relief by the contour method, map scales and slope scales, the drawing of profiles, and the use of conventional signs are briefly but very effectively discussed. In a large measure the treatment is based on experience gained on the western front during the World War. Measurements are given in the metric system, and French maps and French methods receive special consideration. The use and care of surveying instruments and the construction and use of maps are explained in detail, this part of the work comprising nearly two-thirds of the total. The remaining chapters deal with problems falling particularly within the province of the artillery officer.

The text, which is based on articles contributed by instructors on the staff of the Coast Artillery School, is clearly written and well illustrated and will come measurably near achieving the purposes set forth at the close of the introduction, among which are the two following: "To give in a clear and concise form all the information necessary either for an orientation or a battery officer to solve the various problems of orientation that may arise in connection with a battery of heavy artillery executing map firing" and "to present the subject matter in a manner that will be intelligible to an officer who has had no training in civil engineering."

DOUGLAS JOHNSON

RECENT BOOKS ON MAPPING AND SURVEYING

J. K. FINCH. **Topographic Maps and Sketch Mapping.** xi and 175 pp.; maps, diagrs., ills., bibliogr., index. John Wiley & Sons, Inc., New York, 1920. 9 x 6 inches.

W. L. WEBB and J. C. L. FISH. **Technic of Surveying Instruments and Methods.** xvi and 319 pp.; diagrs., ill. John Wiley & Sons, Inc., New York, 1917. $2.00. 6¾ x 4 inches.

C. B. BENSON. **Map Reading for Aviators, with a Chapter on Aerial Navigation.** 56 pp.; diagrs., ills. Edwin N. Appleton, Inc., New York, 1918. $1.00. 7 x 5 inches.

The keynote of "Topographic Maps and Sketch Mapping" is its directness and clarity of presentation. For this reason it should prove especially valuable for the introduction of the

subject to beginners. It assumes that the student has had no preliminary preparation and teaches him how to read a map from its purely mechanical standpoint. No attempt is made at map interpretation. The geological structure controlling the topographic features is ignored.

The second and third parts of the book are devoted to the preparing of simple sketch maps in the field and to landscape sketching. The methods are simple but effective, making available for the use of the layman methods which are used in a more elaborate way by the civil engineer himself. A useful appendix prepared by Mr. F. K. Morris contains a descriptive list of the principal topographic maps of the world.

"Technic of Surveying Instruments and Methods" presents a series of exercises and problems covering the whole field of surveying. It is "not intended to replace any general textbook on surveying, but to supplement the general directions of such a book by detailed directions for specific operations in field and office." It provides definite problems for drilling the student in the use of instruments and explains topographic and railroad surveys by describing the organization, equipment, and personnel of the parties and then in detail the various phases of the work. To the reviewer it seems that a little more instruction might have been given with regard to the plane table, in spite of the fact that reference is made to D. B. Wainwright's "Plane Table Manual" (Appendix 7, U. S. Coast and Geodetic Survey Rept. 1905). In common with most books and texts on surveying it fails to present the methods so nicely developed by the U. S. Geological Survey in this line.

"Map Reading for Aviators" is a pocket-sized booklet which aims to give the main elements of map reading. Map scales, conventional signs, contours and hachures, orientation are taken up briefly but clearly. The explanation of contours is aided by some especially good drawings. Several problems are given, together with the correct solutions, on the determination of speed of flight, correction for wind, and the use of the compass in the air.

A. K. LOBECK

REGIONAL BIBLIOGRAPHIES OF GEOLOGY AND PHYSICAL GEOGRAPHY

W. F. FERRIER AND D. J. FERRIER. **Annotated Catalogue of and Guide to the Publications of the Geological Survey of Canada, 1845–1917.** 544 pp.; maps, index. Geological Survey of Canada, Dept. of Mines, Ottawa, 1920. 10 x 6½ inches.

Changes in system and form of publication since the inception of the Canadian Geological Survey render particularly valuable this analysis of its publications. Separate sections deal with the various types of reports, memoirs, bulletins, guidebooks, etc. A section entitled "Finding Lists" and accompanied by a series of index maps gives a regional bibliography, the arrangement being under provinces and territories. There is also a list according to authors, and an appendix gives a partial list of papers by members of the Survey staff published elsewhere but distributed by the Survey and in some instances still available.

J. BRÜGGEN. **Bibliografía minera i jeolójica de Chile.** 142 pp.; indexes. Soc. Nacional de Minería, Santiago de Chile, 1919. 10 x 7 inches.

The titles included in this bibliography are classified by author under the sections (1) metalliferous deposits; (2) coal and petroleum; (3) salts, including nitrates, other fertilizers, sulphur, building stone; (4) mineralogy and petrography; (5) volcanism and mineral waters; (6) general geography; (7) geology; (8) paleontology. There is an index to each section. In view of Montessus de Ballore's exhaustive bibliography of Chilean earthquakes (*Rev. Chilena de Hist. y Jeogr.*, Vols. 18 and 19, 1916) references to this phase of volcanism are omitted from section 5. The section on geography is likewise short on account of the well-known bibliography "Ensayo de una bibliografía histórica i jeográfica de Chile," by N. Anrique and L. I. Silva. This, however, was published in 1901; and the present bibliography includes very few recent publications under the heading of geography.

Indice geográfico de las publicaciones del Instituto Geológico (1873–1919). *Bol. Inst. Geol. de España*, Vol. 40 (Vol. 20, 2nd Ser.), 1919, pp. 5–120. Madrid.

Indice por orden alfabético de autores de las publicaciones del Instituto Geológico (1873–1919). *Bol. Inst. Geol. de España*, Vol. 40 (Vol. 20, 2nd Ser.), 1919, pp. 5–64. Madrid.

The contents deal almost exclusively with Spain or Spanish possessions, including Cuba and the Philippines, held during the period covered by the bibliography.

T. H. D. La Touche, compiler. **A Bibliography of Indian Geology and Physical Geography, with an Annotated Index of Minerals of Economic Value.** Part I, xxviii and 571 pp.; Part II, ii and 490 pp. Published by order of the Government of India. Calcutta, 1917, 1918. 4 rupees each. 10 x 7 inches.

The author was Director of the Geological Survey of India from 1881 to 1910. The first volume of his present work takes the place of the bibliography compiled by R. D. Oldham and published in 1888. Arrangement in this volume is by authors. Only the minerals of economic value have been indexed as regards subject, and this index with valuable annotations constitutes Volume 2. The arrangement here is alphabetical with regional subdivisions. Numerical references in Volume 2 are to the bibliographical entries in Volume 1; hence it is necessary to use the earlier volume in conjunction with the later. Apparently the field covered includes regions contiguous to India: there are references to Afghanistan and the Malay Peninsula.

Two Governmental Reference Publications

G. P. Merrill, edit. **Contributions to a History of American State Geological and Natural History Surveys.** xviii and 549 pp.; ills. (portraits), index. *U. S. Natl. Museum Bull. 109*, Smithsonian Instn., Washington, D. C., 1920. 9½ x 6½ inches.

This is a volume of historical interest as well as a useful work of reference. It follows along the lines of a work projected by the United States Geological Survey in 1885 but subsequently abandoned. In general the several histories terminate with the date 1885. More recent activities of the surveys have been given in the *U. S. Geol. Survey Bull. 465* compiled under the direction of C. W. Hayes, 1911.

C. S. Sloane. **Fifth Report of the United States Geographic Board, 1890 to 1920.** 492 pp. Government Printing Office, Washington, D. C., 1921.

The volume embraces an account of the history and policy of the board, the report of the subcommittee on a system for transliterating Russian alphabetic characters in the spelling of place names, and all the decisions of the board from its establishment according to (1) general list, (2) Hawaiian names, (3) Philippine names.

CORRESPONDENCE

The Adaptability of the White Man to the Tropics in Australia

To the Editor of the *Geographical Review:*

In a recent number of the *Geographical Review* [August, 1920] there appeared a criticism by Mr. Ellsworth Huntington of a paper by us on the above subject. Mr. Huntington takes exception to a section of the paper dealing with mortality tables for Queensland, which section he describes as "peculiarly inadequate and misleading," and to prove this he makes certain categorical statements some of which are demonstrably incorrect.

These statements cannot be allowed to pass unchallenged, and we must ask permission for a small space in your *Review* in which to answer them.

The section in question was quoted almost word for word from a statement made to us by Mr. G. H. Knibbs, Official Statistician to the Australian Commonwealth, and he has kindly looked over this reply and supplied us with the additional information on the whole State of Queensland given below.

As stated in our paper, statistical data for Tropical Australia have not been published separately by the Commonwealth Authorities. Figures were therefore given for the whole State of Queensland, practically all of which lies north of the 29th parallel of south latitude, and of which 25 per cent of the population live north of the Tropic of Capricorn. This population further represents 95 per cent of the whole tropical population of Australia. It might be expected, therefore, that any unhealthiness of Tropical Australia would have left its impress on the vital statistics of Queensland. The figures furnish no evidence of lack of salubrity in those parts.

It was pointed out in the paper that, in the absence of complete data for Tropical Australia, it was not considered practicable to carry the test further.

Mr. Huntington criticizes these figures on the grounds that the "population of Queensland, especially in the tropical parts, differs from that of an ordinary country" in the following respects:

(1) It is composed of settlers who are more energetic than the average of their countrymen, and is largely migratory.

(2) Most of the people are men from 20 to 40 years of age, ages at which the death rate is low, whilst women, old people, and young children are scarce.

(3) Indoor work in factories is rare.

(4) In a scattered population where officials are scarce, a large number of deaths are not recorded even among highly civilized people.

The following facts show that most of these objections are without foundation.

(1) The recorded figures of arrival and departure by land and sea show nothing more than the normal movement due to business and pleasure shown for the rest of Australia.

(2) At the census of 1911 the proportion of men from 20 to 40 was 33.24 per cent of the male population, that for the whole of Australia being 32.76 per cent; this represents 18.08 per cent of the general population of Queensland, the figure for the Commonwealth being 17.01.

Children less than ten years of age formed 22.73 per cent of the population of Queensland, 22.07 for the whole of Australia. Persons over sixty years of age formed 5.6 per cent of the population in Queensland, 6.41 per cent for the Commonwealth.

The masculinity of the state was only 52.1, 51.9 being the figure for the Commonwealth.

(3) In Queensland, as in other states, the great majority of the population lives in the towns, and indoor work is carried on in shops, offices, and warehouses, etc., entirely by white men. The state has a large number of frozen meat and canning works, and sugar mills, many of which are situated in the tropical area.

(4) The police officials who furnish returns in the outlying districts do their work very efficiently, and it is not possible that large numbers of deaths escape record. Probably only a very small number indeed escape registration.

The above figures represent data for the whole state of Queensland which is seen to be an average state of the Australian Commonwealth, and Mr. Huntington's objections cannot apply to the figures as given in our paper.

Since the paper appeared further statistical data have been taken out for Tropical Queensland by one of us (A. B.), and the results of this investigation are now in the press. A few points may be noted here.

In the coastal areas of Tropical Queensland where the bulk of the population resides, the proportion of males to females (census 1911) is 1.177 to 1; in the inland districts, chiefly mining and pastoral, the proportion is 1.672 to 1.

The average death rates are practically the same in the northern districts of Queensland as in the central and southern districts.

The birth rates are approximately the same in all the coastal districts of Queensland, northern, central, and southern; whilst the infantile mortality rate for the northern districts is lower than those for the central and southern districts.

This enquiry has shown that North Queensland, as far as vital statistics are concerned, does not differ essentially from the rest of the State and compares favorably with Victoria and Tasmania, the two most southern states of Australia.

Unfortunately data were not obtainable for taking out death rates for different ages.

It would be interesting to learn what was the authority upon which Mr. Huntington based his statements.

Yours faithfully,

A. BREINL
W. J. YOUNG

May 19, 1921.

To the Editor of the *Geographical Review:*

Please accept my thanks for your courtesy in sending me a copy of the letter of Messrs. Breinl and Young. I appreciate their earnestness and sincerity in trying to find out the exact truth regarding the adaptability of the white man to the tropics. Their difficulty is the same as that of everyone who studies the health of the tropics, namely, the absence of reliable statistics. Their own data illustrate this. For example, in 1911 the masculinity of Queensland as a whole, that is the number of males per 100 inhabitants, was only 52.1, or 109 males for 100 females; but in the fairly well populated coastal areas of the tropical part of Queensland the proportion of males to females was 118 to 100, while in the inland districts—chiefly mining and pastoral—the proportion was 167 to 100. In other words, in the tropical parts of Queensland the proportion of men is from 8 to 60 per cent greater than in the nontropical parts. But even in the nontropical parts the percentage of men from 20 to 40 years of age (18.08 as given by Breinl and Young) is 10.4 per cent greater than in the "standard" population of the United States in 1900, and 17.9 per cent greater than in England and Wales in 1901.

Among this large proportion of men in the prime of life the percentage who are shut up in the stuffy, dusty air of factories in big cities is certainly far smaller than in England or the northeastern United States; but as to this no data are forthcoming. Similarly, men who are sickly rarely go to tropical Australia. They fear the climate; and also they usually do not have the necessary energy or the capital; but we have no statistics on this point. Once more, almost all the adults in tropical Australia were not only born but grew to maturity in climates of a different type from that where they now live. Hence their health depends on the earlier environment as much, or more, than on that of their present homes. Moreover, unless the people in tropical Australia have less wisdom than most British colonists in hot countries, many go "South" or "Home" when their health begins to suffer, or while the children are young. Thus many deaths are deferred and perhaps credited to other places. In the absence of data on all these points, a mere comparison of crude death rates furnishes little evidence as to the effect of tropical Queensland upon permanent white settlement. I may have been wrong in thinking that many deaths fail to be recorded, for British police are efficient; but the statistics thus gathered are scarcely comparable to those of a settled, permanent, native-born population in a manufacturing country.

It seems to me that Messrs. Breinl and Young have attacked only half of their problem. On the basis of statistics whose inadequacy they are the first to recognize they conclude that there is no "evidence of lack of salubrity in tropical Australia." They have entirely omitted any consideration of the extent to which the statistics are influenced by the conditions mentioned above and by many others. What is needed is accurate statistics tabulated by age, by sex, by race, by place of nativity and childhood, and by climate. A beginning might be made by analyzing the deaths of native-born Queenslanders in the larger towns for a

period of 10 years before the war. This would involve a study of the original records, but it could be done. It would pay because it would give data that could scarcely be questioned.

My own method also leaves half the problem unsolved. I based my statements not on definite information as to Queensland, but on what is known of tropical lands in general, and also on our knowledge of the effect of specific climatic conditions at various seasons elsewhere. For example, the records of insurance companies show that in tropical countries the death rate among policy holders is extremely high. Yet the people who are insured are on the whole the most intelligent and careful of the people who go to the tropics. Again we know that when climatic conditions like those of tropical Australia prevail for a season in any part of our own country the death rate is high.

The point which this discussion emphasizes is the necessity for very accurate and almost meticulously minute statistics of mortality and disease for small geographical divisions and for long periods. The analysis of such statistics is a formidable task, but it is the only way to determine just what effects are produced by different climates and how those effects may be overcome. It is a mistake to attempt to "prove" anything about a climate. What we want is the facts. Knowing these, I believe that we can so regulate our lives that even in the tropics the white man can live and prosper. If we gloss over the unpleasant facts we thereby condemn to weakness and early death many whom the progress of science might otherwise make happy and long-lived.

Yours sincerely,

ELLSWORTH HUNTINGTON